AUDIT AND EVALUATION IN ENVIRONMENTAL ASSESSMENT AND MANAGEMENT: CANADIAN AND INTERNATIONAL EXPERIENCE

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VOLUME II

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A HISTORICAL PERSPECTIVE ON THE ENVIRONMENTAL ASSESSMENT OF LINEAR FACILITIES

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Introduction

This paper describes an environmental assessment that was completed a number of years ago. It was conducted by the United States government as a routing study for a major linear facility. A number of alternative routes for the facility were identified and examined within a study area encompassing over one million square miles (2.6 million square kilometres). Virtually no environmental data existed for this immense study area. Furthermore, there was no highway access into the area. In spite of these constraints, the budget was ridiculously small, and only ten months were allowed between the assignment of the project and the due date for the final report. This is in spite of the fact that the routing decision was of extreme national and international importance and in fact remains to this day one of the most epochal routing decisions in American history.

Despite the severe limitations on the study, the study team produced a preliminary report only 14 months behind schedule. A massive amount of environmental data was gathered and described in the report documents. Following publication of the reports, a fierce battle arose over route selection. This controversy delayed the final routing decision by more than a decade. The final route selection was a political decision, and was not based on the environmental data contained in the reports. The route finally approved for the facility was not the route recommended in the environmental report; in fact, it was not even among the alternatives studied.

Although the project was urgently needed, the project faced numerous delays. The project was not completed until 16 years after the routing studies. Some critical portions of the project were not completed until 30 years or more after the studies.

Once built, the project created a number of severe environmental impacts that were not predicted--or even mentioned--in the reports. These impacts included, among other things, the near-total extinction of the single most important wildlife species on the North American continent.

If any of this sounds familiar to you, it may be surprising to learn that this siting study was performed over 130 years ago. The project described, of course, is the Transcontinental Railroad, and the environmental studies were the Pacific Railroad Surveys of 1853-55. This study was the grandaddy of all government siting studies. Not only was it the first; it was also of such enormous scope and magnitude that it remains unsurpassed to this day. In many respects, it is amazing how many similarities exist between these surveys and many contemporary studies. There are also very significant differences. We believe it is worthwhile to examine the differences in the process that have emerged over the last 130 years. Such a perspective might be valuable for those involved in the day-to-day job of undertaking other major facility siting studies.

This paper contains an overview of the history of the routing studies done for the Pacific Railroad Surveys, with emphasis on the studies for the northernmost route, the Northern Pacific or Stevens Railroad Surveys. Following that overview, the project is examined in light of present-day environmental requirements.

Overview

On March 2, 1853, Secretary of War Jefferson Davis received an assignment from Congress to "conduct field surveys and to prepare a full report of all practicable routes between the Canadian and Mexican Borders for a transcontinental railroad." Davis had little time to think about his assignment. Congress wanted the full report delivered by the first Monday in January, 1854!

Davis wasted no time in organizing the surveys. He divided the entire West into four tiers, each to be surveyed by a different field party (Figure 1). The Northern Tier, extending from St. Paul, Minnesota, to Puget Sound, encompassed a swath of land 150 miles wide between the 47th and 49th parallels. (The region between the 45th and 47th parallels was not surveyed until 1856, although as it turned out the first northern railroad route was to be located in this region.) The next survey to the south was to investigate routes near the 38th parallel from Fort Leavenworth to the Sacramento River. This survey was led by Lt. John W. Gunnison until he and most of his men were killed by the Ute Indians in present-day Utah; Lt. Edward G. Beckwith was assigned to finish out the survey. (The route of the Oregon Trail along the 41st and 42nd parallels was already fairly well-known; it had been partly investigated by Lieutenant John C. Fremont in 1842-44,

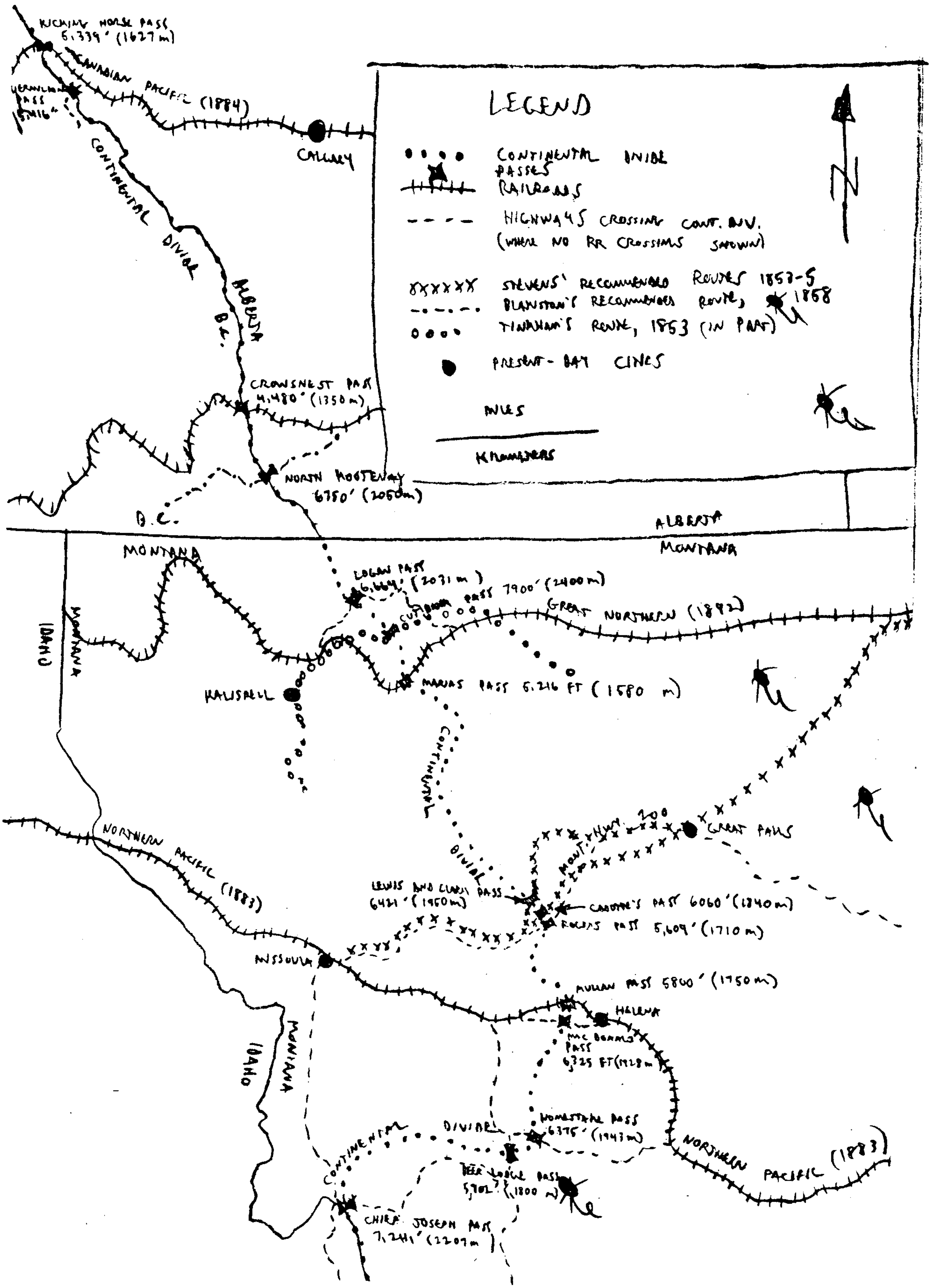

FIGURE 1 SURVEY MAP

by Colonel Stephen Watts Kearney in 1845, and by Captain Howard Stansbury in 1850, and was therefore only partially surveyed during the Pacific Railroad Surveys by Frederick West Lander, a civilian--although, as it turned out, the first transcontinental railroad was finally built there.) The next route passed near the 35th parallel from Fort Smith, Arkansas, to San Pedro, California, and was surveyed by a party under Lt. Amiel Weeks Whipple. The southernmost route passed just north of the Mexican Border from Fulton to San Pedro and was under the command of Lts. John G. Parke and John B. Pope.

Those of us involved in routing studies today must marvel at the magnitude of Davis' assignment. In the space of ten months--one field season--he was to examine all possible routes across the continent within a block of land extending 1100 miles from Canada to Mexico and 1300 miles from the western terminal of the existing railroads to the Pacific Ocean. He was to study an area about which virtually nothing was known, an essential wilderness area populated only by Indians--mostly extremely hostile--and a few trappers, traders and soldiers living at scattered outposts. No roads existed for the transport of personnel and supplies, with the exception of the Oregon Trail and a few wagon ruts or Indian trails. There were no maps worthy of the name, no aerial photographs, no body of literature upon which to draw, no guidelines or methodologies to follow. There were no grocery stores, service stations, restaurants or motels. Davis was to evaluate and compare all possible routes on the basis of the findings of the field surveys and recommend a preferred alternative. And he was to have detailed reports of the findings of the surveys written, edited, reviewed, illustrated, typeset, printed, bound, and distributed ten months later.

The survey for the northernmost route, the topic of most of the following discussion, was assigned to Isaac Ingalls Stevens, newly-appointed Governor of Washington Territory. Stevens divided his immense territory into eastern and western divisions. The western Division, including parts of present-day Washington, Oregon, and Idaho, he assigned to Captain G.B. McClellan. Stevens himself assumed command of the eastern division, including parts of present-day Montana, North and South Dakota, and Minnesota. The Stevens Party was the first in the field, departing from Camp Pierce (in present-day Minneapolis) on June 8, 1853, and proceeding westward. During the summer of 1853, Stevens and his party explored most of today's major highway travel routes through this region, spending much time exploring mountain passes across the Continental Divide in Montana and the Cascade Range in Washington. The Stevens Survey was officially disbanded on April 1, 1854.

In the reports, Davis presented a comparison of the alternative routes considered based on such criteria as grade, elevation of passes crossed, amount of tunnelling required, availability of fuel, snow depth, and cost. In a chapter entitled "Comparison of the Routes," he summarized the advantages and disadvantages of the routes in a manner very similar to some contemporary routing studies. Davis--a staunch Southerner and later (1861-65) president of the Confederate States of America--naturally favored the southernmost route, as it would confer a definite economic advantage to the southern states through which it passed. In his conclusion, Davis said, "A comparison of the results stated above, and of those exhibited in the tables referred to, conclusively shows that the route of the 32nd parallel is, of those surveyed, 'the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean'" (U.S. Department of War 1855, Volume 1, 29). Davis then proceeds to give a very outspoken argument as to why this route would be preferred. The only disadvantage of this route, wrote Davis, was that the lack of forests through this desert region would make it difficult to obtain fuel for the locomotives.

Comparisons

A century and a third have passed since Stevens and his team probed the wilderness passes of the Northern Rockies looking for a railroad route. Since that time sweeping changes have been made in the way siting decisions--indeed, in the way all decisions involving significant actions by governmental agencies--are made. The most important of these changes has occurred relatively recently: the passage of the National Environmental Policy Act (NEPA) in 1969. NEPA contains a number of major provisions that radically altered the way in which governmental agencies made decisions. Perhaps the key provisions are: 1) that environmental consequences must be considered along with other considerations such as cost and engineering; 2) alternatives to the proposed action must be considered, including the "no action" alternative; and 3) a public review process, including publication of draft and final environmental impact statements and scheduling of public hearings, must be followed, and public comment must be considered in the final decision.

NEPA and many other laws, including "little NEPA's" passed by individual states, have totally changed the decision-making environment for routing studies. It has now been 16 years since the passage of NEPA, and many initial rough spots in the process have now been smoothed over. Thousands of routing or siting studies have been conducted, and although there is still not complete consensus regarding siting methodologies, the state-of-the-art is nonetheless highly developed. It is therefore easy to forget that this process is fairly new, and that it is the product of a long and difficult philosophical evolution.

Some very interesting comparisons may be drawn between the Pacific Railroad Surveys study methodologies and decision-making process and the methods and legal processes of some contemporary siting and impact studies. These comparisons may best be made by examining the following question: How would the Pacific Railroad Survey reports measure up to the provisions of NEPA today?

In the following paragraphs, the NPRR decision record, including the report documents, will be evaluated against the standards of NEPA and the Council on Environmental Quality (CEQ) guidelines. At the same time, some comparisons will be drawn between the Pacific Railroad Surveys and contemporary siting studies, and major similarities and differences will be pointed out.

Importance of Decision

Would the Transcontinental Railroad Project be considered a major governmental action significantly affecting the human environment by the standards of NEPA?

The importance of Davis' assignment cannot be overemphasized. In the early 1850s, pressure had been mounting for the U.S. Government to lend its aid in the construction of a transcontinental railroad that would extend rails from their eastern terminus in the midwest to the Pacific Ocean and tie the country together from coast to coast. Such a railroad was needed to transport goods from Eastern trade centers to the Western gold fields, to move natural resources from west to east, to transport military equipment and personnel into the Indian lands, and to provide safer and easier means of travel for settlers heading west. Furthermore, a transcontinental railroad would help solidify the American claim to the still-disputed lands of the West by providing a strong American presence, and would provide a ready channel of communication between the eastern states and the isolated settlements along the Pacific Coast. Without such a railroad, there were three choices available to a person wishing to head west: 1) join a dangerous and tedious seasonal wagon train; 2) hack through the fever-infested jungles of Panama; and 3) travel 13 000 miles by sea around Cape Horn.

Few contemporary siting researchers would admit that the outcome of their extensive siting study efforts is of little consequence, yet many prolonged, extensive routing studies make little real difference over the long term except that perhaps a different public is affected. The decision regarding the location of the first transcontinental railroad, on the other hand, was one of the key siting decisions in American history. It determined not only the pattern of growth and settlement in the American Frontier but set the destiny of major trade centers such as Omaha and Sacramento. The railroad, over 1000 miles long, would tie up over $100 million in scarce capital, and would radically alter the physical, biological, and socioeconomic environments of the lands through which it passed. In light of the importance of the ultimate routing decision, the amount of time and expense spent on the studies seems small indeed.

Size of Study Area

The study area for the Pacific Railroad Surveys was well over one million square miles in size. This is certainly one of the largest study areas for a linear facility in the history of the United States. The only project since that has even approached this area is the Alaska Natural Gas Transportation System. The study area for this project extended from the north slope of Alaska across Canada to distribution centers in the southwestern and central states. Like the Pacific Railroad Survey, its study area encompassed over a million square miles.

Budget Available

In order to evaluate all practicable routes within the vast study area, Davis was given by Congress a project budget of $150 000 (roughly equivalent to $2 million in 1985 dollars). This included $40 000 for each of three survey parties and $30 000 for the fourth. In comparison, siting studies and environmental impact statement (EIS) preparation for small transmission line studies (50 miles or less in length) sometimes exceed $500 000 (in today's dollars).

Time Available

Obviously, Jefferson Davis missed his unrealistic reporting deadline of January 1854. Work began immediately upon the end of the fieldwork in preparing the reports of the expedition. A preliminary report appeared in 1855, consisting of two small volumes with an extra folio of maps. This report contained no illustrations and no scientific data. Later that year, the first volumes of a second edition of this report were published, this time as a series of expensive quarto volumes. Additional technical volumes were issued over the next several years, culminating with a two-volume narrative of the Stevens Survey, including many color lithographs and a synopsis of the zoological and botanical findings of the survey. The final volumes were submitted in 1860.

Davis was certainly not the last project leader to be faced with an enormous task and an impossibly short (ten month) time frame, and to be guilty of missing a deadline. He is certainly not to be faulted for missing his reporting deadline, however, given the impossibility of his assignment. Time frames for completion are now often set by law; review agencies have a set amount of time for environmental study, often related to the size of the project. These time frames are generally adequate, but not excessive, for getting the job done and for providing adequate public review and comment periods.

Many of you probably share our and Jefferson Davis' experience with impossible deadlines--the greater the discrepancy between the time allotted and the time realistically required, the more the deadlines slip and the longer the project actually takes to complete. Musgrove (1985) contends that complex projects take $\underline{e}$ (that is, 2.718) times as long to complete as expected. The Pacific Railroad Surveys come surprisingly close to this value in that the report took 2.4 times the ten months originally given by Congress.

Data Available

In Davis' day, there were virtually no existing data on which to base a routing decision for the transcontinental railroad. Only a few of the many passes across the Rocky Mountains had been traversed. The maps available were sketchy at best. There were, of course, no USGS 7.5' or 15' quadrangle maps, no aerial photography, and no Landsat imagery available. Today, a wealth of data exists for virtually every section of land in the United States. Even remote and inaccessible areas are known through analysis of aerial photography and satellite imagery. Detailed maps at a scale of 1:100 000 or better are available for the entire country, and 1:24 000 USGS topographic quadrangle maps reveal nearly every secret, hidden feature of the landscape over a large percentage of the country. In addition, many states have extensive data bases on environmental conditions throughout the state, and many have digitized data available through geographical information systems.

Access to Study Area

Davis' million-square-mile study area was accessible only by foot, horseback, or canoe. The survey parties generally traveled by pack train over Indian trails or game trails, and often traversed tangled forests of downed timber where not even a game trail crossed. Today, virtually the entire continent is readily accessible by car, airplane, or helicopter.

Hazardous Working Conditions

The survey teams spent months in uninhabited wilderness without adequate medical care. They faced dangerous rapids, grizzly bears, blizzards, and Indians. In fact, Gunnison's party was massacred by the Ute Indians during the survey of the region along the 38th parallel, and had to be replaced by a new party under Beckwith. Working conditions would certainly not meet today's OSHA standards.

Size of Documents

The Pacific Railroad Survey report series consisted of 13 massive volumes and weighed in at 71 pounds. We know of no more recent environmental study documents that even come close to these massive dimensions.

There has been a trend in recent years to keep the size of public siting documents down. CEQ regulations limit federal EIS's to 150 pages for most projects and 300 pages for projects of unusual size or complexity.

Environmental Impact Analysis and Predictive Capability

Environmental impacts were not a concern at the time of the Pacific Railroad surveys. Resources were abundant and largely untapped; there was little public concern for such frivolities as wildlife protection or endangered species preservation. It seemed that there was little man could do to significantly alter the character of the West. Consequently there is virtually no discussion in the NPRR reports of environmental consequences of the proposed action or the various routing alternatives. There is no discussion of irreversible and irretrievable commitments of resources, of the relation between the short-term use of man's environment and the maintenance of long-term productivity, of mitigation, or of monitoring of environmental impacts.

It is probable that the concept of environmental impact did not even exist at the time of the Pacific Railroad Surveys. Some authors (Nash, 1967; Huth, 1957) provide evidence that this concept had its origins with George Perkins Marsh in 1864. His classic work pointed out the enormous changes caused by "human action in the physical conditions of the globe," and suggested that mankind must observe "caution in all operations which, on a large scale, interfere with the spontaneous arrangements of the organic and inorganic world" (Marsh, 1864).

This, of course, has changed radically with the passage of NEPA and other legislation such as the Endangered Species Act and the Fish and Wildlife Coordination Act. Today prediction of the environmental consequences of major governmental actions is one of the primary goals of environmental analysis. A great amount of research has been carried out since the passage of NEPA toward developing and perfecting predictive models and methodologies. Nevertheless the future is as unknown to us today as it was to Davis in the mid-19th Century. Our best predictive models sometimes amount to little more than educated guesses, and the actual consequences of an action are often quite different than the predictions in the EIS. A "worst case" approach is often taken to ensure that any error is on the safe side, as mandated under certain circumstances when consequences are unknown due to a lack of information (CEQ Regulations 1502.22).

In light of the lack of impact prediction in the Pacific Railroad Survey documents, the magnitude of the actual impacts of the transcontinental railroad projects may have come as a surprise to some. The socioeconomic impacts of the project on Indian cultures was devastating. The railroad, once built, contributed directly to the speedy eradication of the bison--the most abundant large mammal on the Great Plains and probably the single most important wildlife species on the North American continent. Even before the golden spike was driven, the great herds had been split into two isolated groups--one north of the railroad and one south. The northern herds persisted the longest but their fate was sealed by the construction in 1883 of the Northern Pacific across Montana. By 1885 only a handful of bison remained alive in the wild. And, of course, with the near-extinction of the bison came the end of the nomadic bison-hunting cultures of the northern Great Plains.

"Opportunistic Research" and Peripheral Environmental Data

Although the Pacific Railroad Survey reports contained nothing in the way of environmental impact analysis, the 71 pounds of paper were crammed full of an incredible amount of scientific information not directly related to the question of railroad siting. Spencer Fullerton Baird of the Smithsonian Institution had been placed in charge of the scientific aspects of the survey, and he made sure that qualified naturalists accompanied all survey parties. As a result of the efforts of Baird and his field people, several volumes of the reports are devoted to detailed treatment of the plants, mammals, birds, reptiles, amphibians, fish, fossils, and insects collected during the surveys. The report contained a complete revision of North American mammals that established the taxonomic treatment followed to this day. Many new species were described and named on the basis of the findings of the survey.

Perhaps the most important scientific findings of the surveys were geographical. The massive survey effort resulted in the first systematic geographical survey of the entire West, and culminated in a detailed map of the west prepared by Lt. Gouverneur Kemble Warren. This map appeared as part of Volume 11 of the reports and was published in 1857. It was the first detailed map of the West and served as the road map for the flurry of settlement and exploration that was to occur in the region following the Civil War.

Like the Pacific Railroad Survey reports, many siting studies and EIS's prepared today contain large amounts of "peripheral environmental data"--information not directly related to the siting questions at hand but of value to "pure" science. For example, scientific studies conducted as part of the environmental assessment of the Trans-Alaska Pipeline System and the Alaska Natural Gas Transportation System produced vast amounts of new scientific information about the relatively unknown landscapes of the interior of Alaska; much of this information was not directly related to routing or impact analysis. This is true on a smaller scale of most environmental studies. Scientists assigned to work on siting projects often use the study as an opportunity to conduct "pure" research on topics of interest to the scientific community but not crucial to the outcome of the siting studies. Such "opportunistic research" is an extremely important but seldom-recognized by-product of NEPA and the environmental assessment process. Some of the most valuable long-term ecological studies in recent decades have come about as follow-up or monitoring studies related to impact assessments. Many such studies are described in this volume.

Evaluation of Alternatives

The major purpose of the NPRR surveys, of course, was the identification and comparison of alternative routes. In this respect, the surveys come fairly close to meeting NEPA's mandate for evaluation and comparison of alternatives. But the criteria used in the comparison of alternatives were strictly limited to engineering, cost, and related concerns. Environmental impacts were not considered at all in evaluation of alternatives. This is one of the major differences between the Pacific Railroad Surveys and studies conducted under NEPA.

However, in certain respects the process has not changed substantially in 130 years. Many siting studies conducted under NEPA give only token treatment to environmental impacts and mitigation; the real siting criteria are still related to cost and engineering, as they were 130 years ago.

Public Disclosure of Record of Decision

The final decision on the route of the first transcontinental railroad was not based on the immense amount of data presented in the survey reports; it was primarily a political decision, and was made in a "smoke-filled room" rather than in the light of day.

Immediately after completion of the Pacific Railroad Surveys, the routing decision was subjected to intense political pressure. Each of the leaders in charge of the various routes surveyed touted "his" route as being the "most practicable." The substantial economic benefits of the project would be focused on the area selected for the eastern terminus, perhaps even to the economic detriment of other potential termini. Therefore, the many would-be terminal cities all up and down the Mississippi argued for the honor (Goetzmann, 1967). The battle for location of the railroad was fierce and lasted well over a decade.

The degree of bias of the key government officials in the routing decision seems unbelievable by today's standards. Jefferson Davis, as Secretary of War, was in charge of the surveys; he was a staunch Southerner and was later to become president of the Confederate States of America. It's not surprising, then, that he argued vehemently and vociferously for the southernmost route--the one that would confer the greatest economic benefits on the southern states. Likewise, Isaac Stevens, as governor of Washington Territory, argued long and hard for the northernmost route--the route that he had surveyed and the one that would bring the economic benefits of the railroad to his own turf. As it turned out, neither of these routes was selected for the first transcontinental railroad project.

Today, NEPA aims to prevent the expression of such bias in decisions by taking the decision-making process out of the smoke-filled room and subjecting it to public scrutiny at all stages. This is one of the most significant innovations of NEPA, one which is slowly being emulated by governments of other countries. Nevertheless, although NEPA ensures that decisions are made with all the cards on the table, it has not been--and cannot be expected to be--completely effective in preventing decisions from being influenced by political bias of key decision-making officials.

Delays and Length of Process

The Pacific Railroad Surveys were completed in 1854. During the six years it took to prepare the final reports, some major changes took place. The financial backing for the railroad project faltered; the great gold strikes in California were played out and new strikes were made in Colorado and Montana. Perhaps most important was the Civil War, which occupied the full attention of the country for four years or more and left the country with a mountain of debt. As it turned out, the first Transcontinental Railroad was completed on May 10, 1869, 16 years after the field studies. It was Abraham Lincoln's administration that made the final routing decision and chose Omaha as the eastern terminus. A railroad was not built along Davis' preferred routes until 1883, three decades following the field surveys. No railroad was ever built along Stevens' preferred route, although the Northern Pacific Railroad was built to the south of Stevens' route in 1883, and the Great Northern was built to the north of his route in 1892--nearly four decades after the surveys.

Today, it is common to hear complaints from industry that the environmental review process unnecessarily delays needed projects. A commonly-cited example is Colstrip Units 3 and 4, a coal-fired generation project in southeastern Montana. The application for the plants was filed with the State of Montana in 1973. The application was approved by the state in 1976, but final approval from the U.S. Environmental Protection Agency was delayed. All told, construction of the facility began approximately one decade after the initial application. This seems like a modest delay in comparison to that of the Railroad project; like the railroad, the delay was not due entirely to the environmental review process but to external factors such as changes in pollution control technology and in the demand for electricity.

Success in Locating the Best Route

How successful were the Pacific Railroad Surveys in picking the "most practicable route" for a transcontinental railroad? Not very. As mentioned earlier, the final route chosen by President Lincoln was not among those recommended in the survey documents; it was not even among the routes surveyed.

The Pacific Railroad Surveys amounted to a search for easy ways to cross the Continental Divide and other major mountain ranges with a railroad grade, and their success in this regard depended almost entirely on their success in locating low-elevation mountain passes with gentle grades approaching from either side. That the Surveys just barely missed the most suitable passes in the entire Rocky Mountain chain is one of the most interesting accidents of American geography, and is worth consideration here.

First of all, the Pacific Railroad Surveys failed to locate the one pass that would make the transcontinental railroad possible. The route finally chosen was one closely following the Oregon Trail, and was not among the routes recommended by Stevens, Davis, or the other survey participants. It was made possible by the discovery in 1866--12 years after the railroad surveys--of a pass called Evans Pass that proved to be far more feasible than any of the passes examined during the Pacific Railroad Survey. Before this pass was discovered, the railroad route crossed impossibly high and rugged terrain in the Laramie Mountains of Wyoming, and construction would have been extremely difficult and expensive.

Second, Isaac Stevens and his survey parties identified several passes across the Continental Divide in Montana, but missed the best ones--the ones that were eventually to be crossed by railroads decades later. Stevens recommended that the railroad route cross the Continental Divide either at Cadotte Pass at 6060 feet (1840 m) or at Lewis and Clark Pass at 6421 feet (1950 m) (Figure 1). Today, only a power line crosses Cadotte Pass, and Lewis and Clark Pass is crossed only by a nearly-impassable jeep trail. One of Stevens' lieutenants, John Mullan, discovered a pass now named Mullan Pass just a few miles to the south of Cadotte Pass. This pass, at 5800 feet (1750 m) is much more suitable for a railroad and was in fact the first northern pass across the Continental Divide to be crossed by a railroad (in 1883). Stevens considered linking Mullan Pass with Great Falls, traversing some extremely difficult terrain en route, but he did not consider linking Mullan Pass with Helena and eventually the Yellowstone River Valley--the route finally taken by the Northern Pacific in 1883.

It is remarkable that Stevens narrowly missed discovering the lowest pass across the Continental Divide between the Canadian Border and Lordsburg, New Mexico--Marias Pass, at 5216 feet (1580 m). Stevens had heard rumors from the

Indians that such a pass existed, and he sent two survey detachments into the field to investigate it, in October of 1853 and again in spring of 1854. The first detachment overshot Marias Pass and instead crossed a high (7900 feet or 2400 m), steep, and impossibly difficult pass (now called Cut Bank Pass) located in what is now Glacier National Park. The second detachment looked up the valley of Marias Pass at a distance, but could not actually explore the pass in the time allowed. Marias pass was not discovered until 1889, and the Great Northern Railroad was finally constructed across it in 1892, nearly 4 decades after the Stevens Surveys. It is tempting to speculate how the history of the West may have changed had Stevens and his party discovered and explored this pass in 1853-54.

Conclusions

History has shown that the Pacific Railroad Surveys did more harm than good to the idea of a transcontinental railroad (Goetzmann, 1967). The infighting among proponents of alternative routes was to contribute to a delay of over a decade and a half in constructing the line. In the final analysis, the importance of the Surveys lies in the scientific and geographic data gathered--particularly Warren's map.

While the passage of landmark legislation such as NEPA marked a turning point in governmental decision-making, many studies conducted today still lapse back to the days of Davis and Stevens. They contain only token consideration of environmental impacts, have poorly-defined predictions, rely almost exclusively on cost and engineering criteria in comparing alternatives, and many decisions are still political in spite of NEPA's mandate for public disclosure.

Whether or not budget, time, available information or the process are adequate, the decision eventually falls to someone who is in charge and who must balance the factors contributing to the decision. Only the fact that decisions are made in the light of day has significantly affected the choices and reasons the decision-maker will reveal in making a decision. It is hoped that this overview of the forerunner of all siting studies will give you a broader perspective from which to approach your environmental assessment work.

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PART I

IMPACT PREDICTION, MITIGATION, AND MONITORING

DECISION MAKING BY VOLUMINOUS SPECULATION: THE CONTENTS AND ACCURACY OF U.S. ENVIRONMENTAL IMPACT STATEMENTS

Paul J. Culhane

Introduction

During the decade following the signing of the National Environmental Policy Act (January, 1970), 75 federal agencies in the United States wrote 10,475 environmental impact statements (U.S. Environmental Protection Agency, 1980). These EISs range in size from skimpy, early documents of under a dozen pages to some massive, multivolume tomes. These documents have seemed to be such a good idea that the act's procedures have been copied, with greater or lesser faithfulness to the original, by over two dozen state governments in the U.S., the Government of Canada and most European community nations (Medford, 1973; Wandesford-Smith, 1978; and Environmental Resources Ltd., Hart and Enk, 1984), and U.S. officials concerned with "inflationary impacts", "arms control impacts", "regulatory impacts", and "urban impacts". Chief Justice Warren Burger, of the judiciary that ensured the original EIS legislation would have a major impact on the work load of the federal bureaucracy, has even called for "judicial impact statements" on the effects of new legislation on the courts' work load. If the concept of environmental impact statements is so admired and often imitated, how good are these documents in practice?

Academic observers have developed three alternative models about how the U.S. NEPA process has improved federal decision making. Depending on which one is chosen, NEPA has brought the technical precision of science to bear on resources decision making, imported environmentally sensitive officials into previously insensitive bureaus, or opened up otherwise parochial agency decision processes to the cleansing light of public scrutiny and review. The strongest advocate of the scientific model of NEPA reform is Caldwell (1982). Most of the prescriptive literature on EIA is aligned with the rational analytical model (see Canter, 1977). Good examples of the "internal reform" position can be found in Wichelman (1976), Fairfax and Andrews (1978), and Taylor (1984). Proponents of the "external reform" position include Liroff (1976), Andrews (1976), and Friesema and Culhane (1976).

This study focuses upon the first of the three alternative visions of NEPA reforms. If EISs are rational, analytical documents they should contain sets of comprehensive, competent predictions about the consequences of agencies' proposed actions. A comprehensive, competent prediction should, first, meet some standard of technical sophistication. Different advocates advance slightly different standards, such as the use of quantified forecasts or reliance on state-of-the-art scientific theory about an impact. However, rationalist reformers generally presume that the more analytical and quantified an EIS prediction, the better it is. Second, the predictions should be correct. If a collection of technical, quantified, and seemingly sophisticated predictions is systematically wrong, then any decision based on those predictions can be right only by virtue of dumb luck.

In one way or another, most of the investigators in this volume seek to answer similar questions. Those questions remained unanswered for a rather long time, however, because the time required for project impacts to occur poses a fundamental trade-off for environmental auditors. The Wisconsin Power Plant Study of the Columbia Station (Loucks, 1982) provides a model example of one auditing alternative: monitoring was conducted by a coordinated, interdisciplinary team of university scientists who used an integrated theoretical framework, began their assessment before completion of the plant, and employed impact monitoring designed to exacting scientific standards. The evaluation strategy adopted here is at the opposite end of the spectrum of trade-offs from that of the Columbia study. The diverse range of impacts forecasted in a variety of EISs is examined; these forecasts cover the gamut of physiographic, biological, social and economic impacts, plus mitigation measures and project objectives. Relying on the extant data, rather than conducting our own monitoring, the evaluation was performed at a moderate cost. The trade-off, however, was to sacrifice the exacting raw-data-collection standards of the Columbia study. Given the intrinsic complexity of the impacts examined, the data limitations in the real world of project implementation, plus the vagaries of EIS forecasts, our conclusions about the fairly reasonable accuracy of U.S. EISs must be cautiously hedged.

Methodology

The objective of this audit is to evaluate the match between the impacts forecast in a representative set of EISs with the impacts that actually occurred following project implementation. A sample of 150 documents filed between 1974 and 1978, catalogued by the U.S. Environmental Protection Agency (1980), was randomly drawn from the universe of EISs. After determining if an when each EIS's proposal had been implemented, a field sample was selected to satisfy four criteria: (1) similar numbers of cases within five major classes of projects; (2) to lower fieldwork costs, projects were selected in ten geographic clusters; (3) to allow five years of post-project data, projects implemented before 1979 were strongly preferred; and (4) EISs were preferred that had been written from 1975 onwards, when the NEPA process had become institutionalized in most federal agencies. The field sample of 29 cases (listed at beginning of reference list) consists of six projects apiece in the water resources, public lands, highway, and urban/buildings categories, and five energy projects. It includes subsamples from such major EIS-writing agencies as the Federal Highway Administration, Corps of Engineers, Atomic Energy Commission and its successor agencies, Forest Service, and the Department of Housing and Urban Development. The projects are broadly distributed throughout all regions of the U.S. except (by chance) the southwest.

All forecasts within the field-sample EISs were content analyzed. A "forecast" is defined as any passage in final EISs about the future consequences of the proposed action. The 29 final EISs contain a total of 1,105 forecasts. The research team coded twelve indicators per forecast using a pretested and refined protocol. The recorded intercoder disagreement rate across these 13,260 codes was a low 3.36%. However, an independent recording by a single investigator showed a much higher 11.5% rate of disagreement between codes on nine items in the 288 forecasts for which field data were gathered and the corresponding codes in the first content-analysis round. Given the peculiarities of the two types of coding, the true reliability rate is probably in the 90%-95% range.

Two of the coding items describe basic characteristics used to select candidate forecasts for fieldwork. The first indicates whether the forecast falls into the substantive category of physiographic (302 forecasts, 27.3%), biological (169, 15.3%), economic (168, 15.2%), or social (447, 40.5%) impacts. Many forecasts could plausibly be coded within two or more of these categories. Such true, but messy arguments were peremptorily ignored, and all but 19 forecasts are coded within the four primary categories. The second classification indicates whether a forecast dealt with impacts of the project (832 forecasts), project objectives (93), or mitigation measures (180).

This study's basic model of impacts is a pre- and post-project interrupted time series design, in which the project presumably causes any discontinuity in the series. This model of impact accuracy requires an ideal EIS forecast to provide at least two pre-project baseline observations on an affected parameter and two post-project forecast values to define an impact trend. Impact accuracy is then inferred by comparing actual post-project observations with the forecast trend and the pre-project trend. The investigators originally proposed to evaluate impact accuracy using a pooled cross-sectional time-series statistical model (Dean and Stimson, 1980; see also Cook and Campbell, 1979).

Data were sought during fieldwork on one or more forecasts per EIS within seven categories: physiographic, biological, economic, and social impacts, mitigation measures, project objectives, and controversial impacts. The teams attempted to acquire time-series data bearing on the predicted impact from existing sources, such as the records of lead agencies and general government. The teams also conducted 120 interviews with informants familiar with the projects to identify any significant impacts that EIS writers failed to anticipate and obtain explanations or opinions about patterns in the data.

Adequate quantified data proved to be available for only 53% of the 239 impacts. Moreover, good data are unevenly distributed among both impact categories and EIS types. The field teams acquired time-series data most often on economic impacts (42 of 89 time series), but found it most difficult to obtain quantified data about biological impacts (only 9 quantified biological data sets). On the other hand, non-quantitative evidence is quite appropriate for certain forecasts; 44 of the forecasts are audited based upon nominal status (e.g., the dichotomy of whether or not a mitigation was carried out) and 69 upon interview or documentary information. The teams failed to obtain any adequate information on 29% of the 239 forecast impacts sought in the field, with physiographic data the most difficult to acquire. Data and information obtained in the field are rated based upon factors such as the congruence between the data's and forecast's referent population and confirmation of interview information by multiple sources. Impacts with non-quantitative information as the primary type of data are usually rated as "adequate", with 84% rated as "adequate" or better. Quantified data are more likely to receive the highest, "exact" rating, but are also more prone to "low adequate" ratings. So, with 97 cases' data rated "exact", 94 "adequate", and 48 "low adequate", the fieldwork data are of mixed quality.

The sophisticated pooled cross-sectional time-series statistical model proved to the simplistic and inappropriate in the face of the real-world variance in project impacts, impact data, and forecasts. First, the biases and quality variances in the available time-series data render a pooled statistical analysis invalid. Second, perfectly appropriate measures of impact include dichotomies, single-number post-project readings, and short uninterrupted time-series...none of which conform to the interrupted time-series model. In the study's sample of 239 impacts, these measures also involve 103 distinct impact types and 53 different units of measurement. Third, as described in the next section, EIS forecasts do not routinely meet the quantitative assumptions underlying the pooled statistical design.

The pooled model was thus replaced by an inelegant, but aptly descriptive, case-by-case rating scheme. These ratings rely on what Donald Campbell calls an "interocular trauma test"...what effects hit you clearly between the eyes? The rating scheme consists of three comparisons of actual impacts with forecasts: the direction of the impact, relative to the forecast direction (7 codes); the match between forecasted conditions and actual impacts (20 codes); and the relative beneficiality of the actual impact (12 codes). The scheme also allows both primary ratings and secondary ratings.

The Contents of EISs

EISs may be expected to consider almost anything and everything and, indeed, 188 distinct types of impacts appeared during the coding of the field-sample EISs. Some impact types are mentioned frequently by EIS writers; such as noise, soil erosion, and archeological or historic effects (44, 35 and 36 forecasts, respectively, among the 1,105 total forecasts in the 29 sample EISs). Other impact types may be discussed several times, with relevant variations, in an EIS on a particular type of project: for example, property owner displacement in highway EISs (21 forecasts), or radiation effects in nuclear EISs (29 forecasts). On the other hand, many unusual or unique impact types, such as age discrimination or wild ecosystem preservation, are forecast only once or twice in the sample EISs. EISs also contain a few inane forecasts; for example, the most common type (11 of 25) of mixed-category forecast alludes to "environmental impacts" without indicating which environmental impact. The diversity of forecasts...the large number of noncomparable but often quite salient impact types, each the turf of a different disciplinary specialist...makes the task of evaluation quite formidable.

The vagueness of the typical forecast also poses a major challenge in the evaluation of EISs' accuracy. An evaluatable forecast should contain, of course, post-project numbers that can be compared with the actual impact trend. Quantification is the essence of the ideal prediction depicted in the prescriptive and evaluative literature on environmental assessment (e.g., Carter, 1977; Bisset, 1984). That literature holds that the ideal EIS prediction (1) is quantified using (2) a technically appropriate unit of measurement, and clearly identifies (3) the affected populations or resources that are measured and (4) the time at which the effect is to occur; it should also (5) explicitly state the significance of the impact and (6) be qualified by an estimate of the probability of occurrence of the impact. Furthermore, many assessment methodologies endeavor to translate predictions into quanta that can be manipulated by some algorithm to compute which alternative is optimum.

The modal EIS forecast falls short of this ideal in several respects. As shown in Table 1, less than one-quarter of EIS forecasts in the sample are quantified, and only 2% are time-series forecasts. Another 11% are forecasts of "no impact", which could be translated into a semi-quantified forecast of zero change (e.g., in the slope of a time trend line). Almost two-thirds of the forecasts are coded as "verbal" forecasts. Similarly, only a minority of forecasts are couched in commonly recognized units-of-measurement: ppm, mg/l, acre-feet, dollars, KWe, dBA, average daily traffic, etc. Biological forecasts suffer from a particular paucity of measurement units. The two biological measures, wildlife population counts and species-diversity indices, however, are supplemented by "acres", a mixed-category measure (N=42) used often in biological forecasts. A fifth of the sample's verbal forecasts deal with mitigations, a special class measurable as a "done/not" dichotomy. However, most forecasts are simply unquantified and ill-quantifiable.

Other characteristics of forecasts are likewise not conducive to precise analysis of predictive accuracy. Only one-quarter of the forecasts contain an explicit statement of the significance of the prospective impact. (That quarter are seven times more likely to forecast insignificant impacts than significant impacts). The likelihood that a forecast impact will occur is almost never expressed as a quantified probability, and must in 87% of forecasts be inferred from the semantic meaning of keywords like "will" or "could". Finally, a "vagueness index", which counts the number of weak characteristics in a given prediction (e.g., no measurement unit, unclear forecasted direction of impact), shows a mean value of

TABLE 1 CHARACTERISTICS OF FORECASTS THAT ARE CLOSELY RELATED TO THE MODEL OF AN IDEAL EIS PREDICTION: QUANTIFICATION, UNITS OF MEASUREMENT, SIGNIFICANCE, AND CERTAINTY. N=1, 105 FORECASTS IN 29 FIELD-SAMPLE EISs.

	Forecasts	
Quantification of Forecast	No.	Percent
Quantified: Time-series	21	1.9%
Single-number post-project value	164	14.8%
Post-project values, multiple indicators	51	4.6%
Range-of-values forecast	17	1.5%
Percentages, re nominal classification	9	0.8%
"No impact" forecast	123	11.1%
Verbal, unquantified forecast	720	65.2%
	1,105	100%

	Forecasts	
Measurement Units, by Category (No. Measures)	No.	Percent
Physiographic measurement units (18)	69	6.2%
Biological measurement units (2)	7	0.6%
Mixed-category measurement units (7)	73	6.6%
Economic measurement units (12)	89	8.1%
Social measurement units (18)	85	7.7%
Mitigation measures (3)	162	14.7%
No measurement unit, other than restatement of impact	620	56.1%
	1,105	100%

	Forecasts	
Significance of Forecast Impact	No.	Percent
"High" (or synonym, explicitly stated)	32	2.9%
"Moderate" (or synonym, explicitly stated)	8	0.7%
"Insignificant" (or synonym, explicit)	285	25.8%
Quantified, without explicit statement of significance	163	14.8%
Vague/ambiguous significance statement	78	7.1%
No explicit statement of significance	539	48.8%
	1,105	100%

	Forecasts	
EIS's Certainty About Forecast Impact	No.	Percent
Quantified probability	1	0.1%
Certainty guaranteed by situation	74	6.7%
Impact conditional upon intervening event	62	5.6%
Probability implied by keywords "will", "will not", etc.	641	58.0%
Possibility implied by keywords "may", "could", "may not", etc.	318	28.8%
	1,105	100%

2.4 (s.d. = 1.52) and a high value of 7; only 14% of the forecasts had a perfect score of zero on this index. In short, the characteristics of the modal forecast make it difficult to know exactly what future condition EIS writers expect and, therefore, what future values of a relevant indicator would constitute an accurate forecast.

Forecast Accuracy: Example Cases

As noted above, forecast accuracy is evaluated using a case-by-case rating scheme. The rating scheme contains a total of 39 codes describing the direction of the impact, the match between forecast conditions and actual impacts, and the relative beneficiality of the impact; it also allows both primary and secondary ratings. The primary "match" rating is the best single classification of forecast accuracy; these ratings range from "close", indicating perfect or very good accuracy, through a series of complicated classifications, to "inconsistent". As case-by-case comparisons of diverse impact data with specific forecasts, the best way to understand the system is to follow it through several example cases.

Paint Creek Dam: Limnology

Construction of the Corps of Engineer's Paint Creek Dam began before 1970 and was completed in 1974, shortly after the filing of the Paint Creek final EIS. A physiographic forecast in the EIS predicts thermal stratification in the reservoir during warm months, a 10-20 foot deep epilimnial strata, and anaerobic conditions in the hypolimnion. These conditions indicate eutrophication, a common problem in warm-water reservoirs such as Paint Creek. The Corps kept good monitoring data of temperatures and dissolved oxygen at 2-5 foot depth increments at various sampling locations in the reservoir, with monitoring performed at about monthly intervals from 1975 to the present. Epilimnion and hypolimnion depths can be estimated from raw temperature-depth readings using a simple BASIC program.

The relationship of hypolimnion depth (solid line) to the depth at which DO concentrations fall below 1.0 mg/l (dashed line) is shown in Figure 1. Anaerobic conditions exist in Paint Creek's summer hypolimnion strata, and indeed anaerobic conditions often extend ten or more feet up into the thermocline (which was fairly indistinct on some monitoring days). Epilimnion depth, though not shown in Figure 1, is usually closer to 10 feet than 20 feet. Thus, the Paint Creek limnology impact, which poses one of the most complicated data-assembly tasks in the study, provides an example of a fairly accurate forecast that received a "close" rating, and an impact rated "as adverse" as predicted.

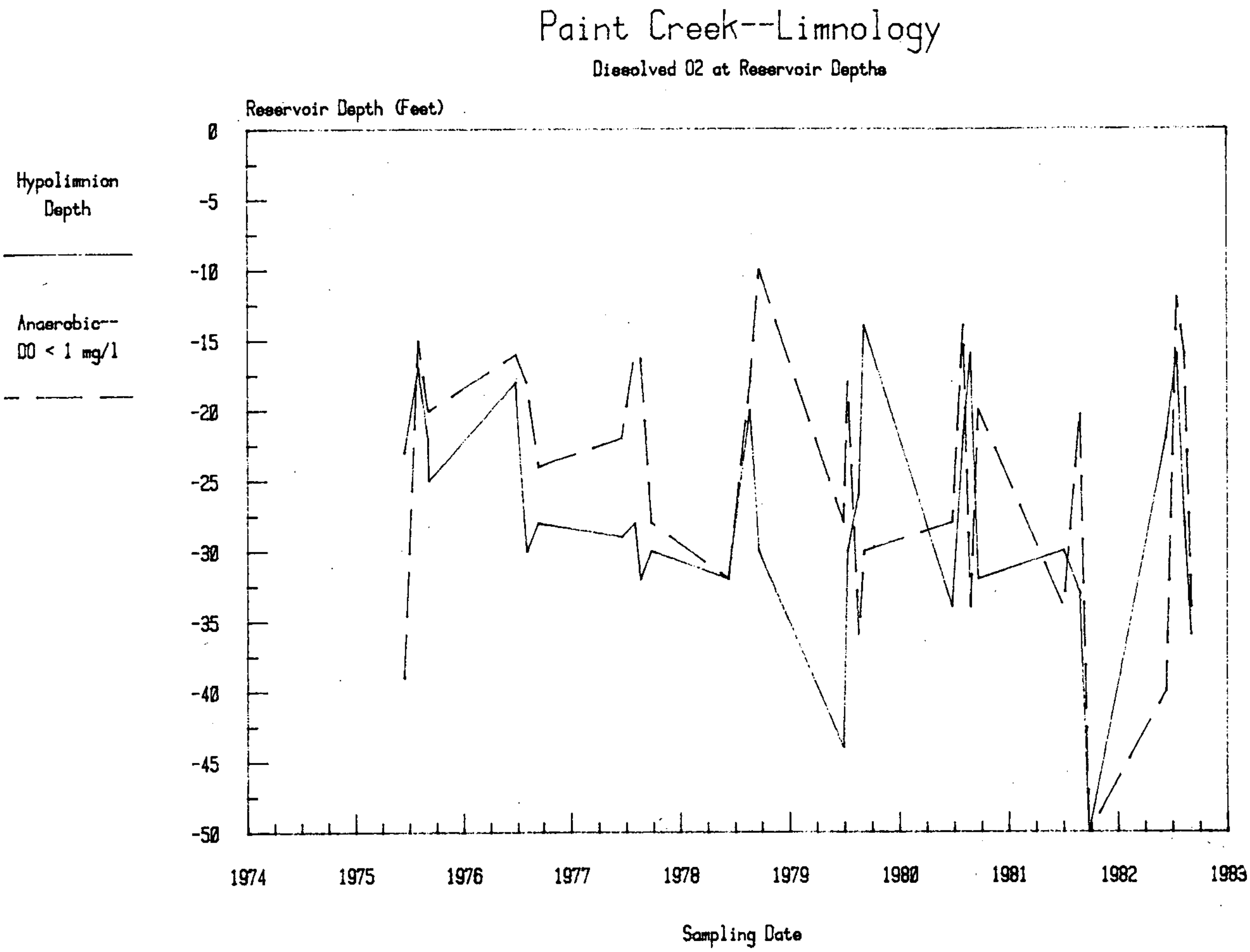

FIGURE 1 EXAMPLE FORECAST CLASSIFIED "CLOSE": LIMNOLOGICAL CONDITIONS IN PAINT CREEK RESERVOIR, CENTRAL OHIO. FORECAST: "... EXPECT ... THERMAL STRATIFICATION IN WARM MONTHS, WITH EPILIMNION RANGING BETWEEN 10 to 20 FEET (AND) ANAEROBIC CONDITIONS IN THE HYPOLIMNION ...." FIGURE PLOTS THE DEPTH OF THE HYPOLIMNION AND THE DEPTH AT WHICH DISSOLVED OXYGEN DROPS BELOW 1.0 mg/l; BOTH DERIVED FROM MONTHLY SAMPLES OF TEMPERATURE AND DO AT RESERVOIR DEPTH INCREMENTS. FULL RESERVOIR POOL ACHIEVED JUNE, 1974.

Weymouth-Fore and Town Rivers: Rock Blasting

The Weymouth-Fore and Town rivers share a common channel to Massachusetts Bay and are part of the Port of Boston. A 1974 Corps EIS proposed to remove rock outcroppings to complete channel deepening. The safety of blasting operations was a very salient social impact of the project, so the Corps promised to monitor blasting operations to ensure that all blasts resulted in no more than 0.5 inches per second particle movement velocity at the closest onshore building. This limitation was lower than normal because of the proximity of blasting operations to onshore petroleum storage tanks.

The Corps hired a consultant to conduct seismic tests during each blast. Only three readings during 36 blasting days exceed 0.23 inches/second PMV, that is, less than half the EIS-specified limit. One reading equals 0.53 inches/second, but the 0.03 increment can be rounded down to the forecast 0.5, and not treated as a violation of the EIS limit. For comparison during its first monitoring, the contractor measured the vibration of a small child jumping on a carpeted floor at the same house to be 0.52 inches/second.

While the actual impact of Weymouth-Fore rock blasting is rather insignificant, it provides an example of several complexities encountered in auditing forecast accuracy. First, the seismic readings are excellent time-ordered...but not interrupted time-series...construction-phase data. Second, the forecast is couched in terms of a limit and any data values less than that limit would constitute an accurate impact. Thus, this impact is rated as "close" to the forecast, but since the actual blast vibration was almost always less than half the 0.5 limit, the impact is also rated as "less adverse" than the forecast implied. Third, this case involves both an impact, the vibration effects of blasting, and a mitigation measure, the monitoring of blast vibration. Thus, this case receives a "mitigation done" secondary match code.

Shepard Park Development: School Enrollment

It is often more difficult to interpret some of the vague forecasts in the study's sample than to determine the post-project impact. The Shepard Park development involves eight blocks of mostly high-rise or mid-rise residential buildings in an already urbanized section of St. Paul, Minnesota. One of the social forecasts in the 1977 Department of Housing and Urban Development EIS on Shepard

Park noted that school enrollments were declining at the local school and in St. Paul generally and that, therefore, the school system "has sufficient capacity to handle additional students from the Shepard Park Development". Enrollment figures are available for both the local school, Homecraft, and for the St. Paul school system.

School enrollments indeed declined both before and after the Shepard Park EIS, with an even steeper decline in Homecraft enrollment (solid line in Figure 2) than in total St. Paul enrollment. Homecraft's enrollment levels off in 1978, but this effect cannot be clearly attributed to Shepard Park: enrollment stabilizes during Fall, 1978, but the first Shepard buildings were occupied later and contain either "luxury" apartments with relatively few school-age residents or senior citizens' units with no school-age residents. In any case, how does one evaluate any data in terms of the forecast? The phrase, "has the capacity", allows any Shepard-caused impact ranging from a net decrease in enrollment to a doubling of enrollment from the 300-student level of 1977-78 back up to the almost 600-student level of 1970-71! Solely by virtue of its latitude, the forecast is not inaccurate.

Grand Teton Master Plan: Wilderness

This case provides an example of an outcome whose interpretation is definitionally complex (as well as an impact that is validly measured by a single post-project number). In its 1975 Grand Teton National Park master plan EIS, the National Park Service proposed designation of 115,807 acres as wilderness. In 1978, after a detailed boundary survey, the wilderness proposal was increased to 122,604 acres. The Grand Teton National Park wilderness was included on the official, 1978 list of administration-endorsed additions to the national wilderness system, and has remained on that list to the present. The Park Service has managed the area since 1976 exactly as it would if it were officially designated wilderness. However, Congress has never bothered to designate (or reject) this, or any other of the National Park wilderness candidates, because its attention was absorbed by conflicts over proposed Forest Service wilderness areas.

This case is factually clear: the current 122,604-acre area is essentially the same as the EIS's 115,807-acre proposal. The question is, is the area a "wilderness"? _De facto_, it is managed by the Park Service and used by the public as if it were a wilderness. But, _de jure_, an official "wilderness" is an area statutorily designated by Congress. _De facto_, the forecast is accurate; _de jure_, it is inaccurate. As researchers familiar with federal wilderness policies, we classify this outcome as "complex, but basically accurate".

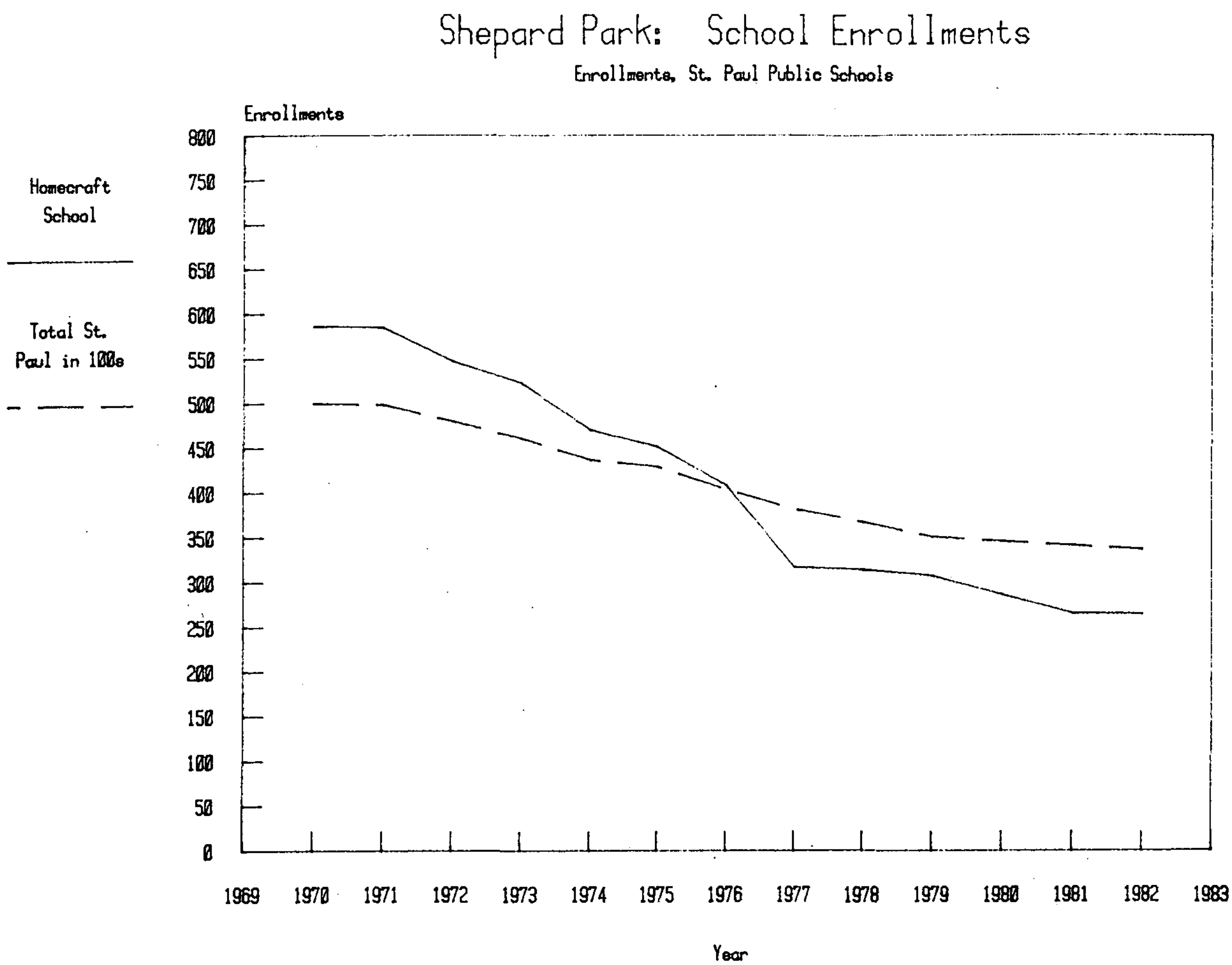

FIGURE 2 EXAMPLE FORECAST CLASSIFIED "WITHIN RANGE OF A VAGUE FORECAST": SCHOOL ENROLLMENT NEAR SHEPARD PARK APARTMENT BUILDING COMPLEX, ST. PAUL, MINNESOTA. FORECAST STATES THAT, DUE TO DECLINING ST. PAUL SCHOOL ENROLLMENTS, THE LOCAL SCHOOL SYSTEM "HAS SUFFICIENT CAPACITY TO HANDLE ADDITIONAL STUDENTS FROM THE SHEPARD PARK DEVELOPMENT." FIGURE PLOTS THE ANNUAL ENROLLMENT AT HOMECRAFT SCHOOL, WITHIN WHOSE BOUNDARY THE DEVELOPMENT LIES, AND ST. PAUL SCHOOL SYSTEM TOTAL ENROLLMENT. MAJOR BUILDINGS IN THE DEVELOPMENT WERE COMPLETED AT ABOUT ONE-YEAR INTERVALS FROM DECEMBER, 1978, TO AUGUST, 1982.

Weymouth-Fore and Town Rivers: Shipping Drafts

Economic benefits are often the key objectives of EISs' projects. Economic forecasts tend to be less accurate than other forecasts, and the main economic objective of the Weymouth-Fore project provides a good example of an outcome classified as "inconsistent" with its forecast. The forecast states that the channel work would "allow deeper draft tankers" to use the Weymouth-Fore and Town rivers harbour. This is the key assumption in the cost-benefit analysis justifying the project, not a minor forecast; Corps' economists assume that the same tonnage will use the harbour, but savings result from a shift in tonnage from inefficient shallow-draft hulls to fewer deeper-draft vessels. So, one would expect an increase in a 30-foot or greater draft inbound vessels (outbound vessels become shallower due to off-loading) from 1977 onwards, and a corresponding decrease in shallow tankers.

Actually, the reverse occurred. After the channel was deepened beyond its original authorized depth of 28 feet in 1977, the number of 30+ foot ships decreased from the 1969-75 range of 50-30 ships to the 15-25 range during 1978-81 (see Figure 3, solid line). Also after 1977, the number of shallow, 18-foot or less tankers increased. What happened is that the principal customer for deep-draft tankers closed coterminously with the channel deepening. Boston Edison's B.E. Edgar Station's coal/oil wharf is located at the confluence of the Weymouth-Fore and Town rivers, on a large natural turning basin. Before the 1974-76 channel work 30+ foot tankers could sail up to the Edgar Station wharf on high tide, off-load as the tide receded, and then take advantage of the large turning basin to sail outbound. However, the Edgar Station closed in the wake of the oil-to-coal conversion policy of the mid-1970s energy crisis. By 1982 tanker destinations were limited to Citgo, Mobil, and Quincy Oil gasoline tank farms upriver, where access is difficult except for shallower tankers and barges.

Newington Forest Subdivision: Firing Range

More than one quarter of the impacts in the sample, particularly social impacts, are audited based on verbal or documentary information. The Newington firing range case provides an example of an impact for which such information is perfectly reliable. Newington Forest subdivision was built between 1977 and 1982 in suburban Fairfax County, Virginia, south of Washington, D.C. The subdivision is located just north of a D.C. prison and police academy firing range. HUD's 1977 EIS

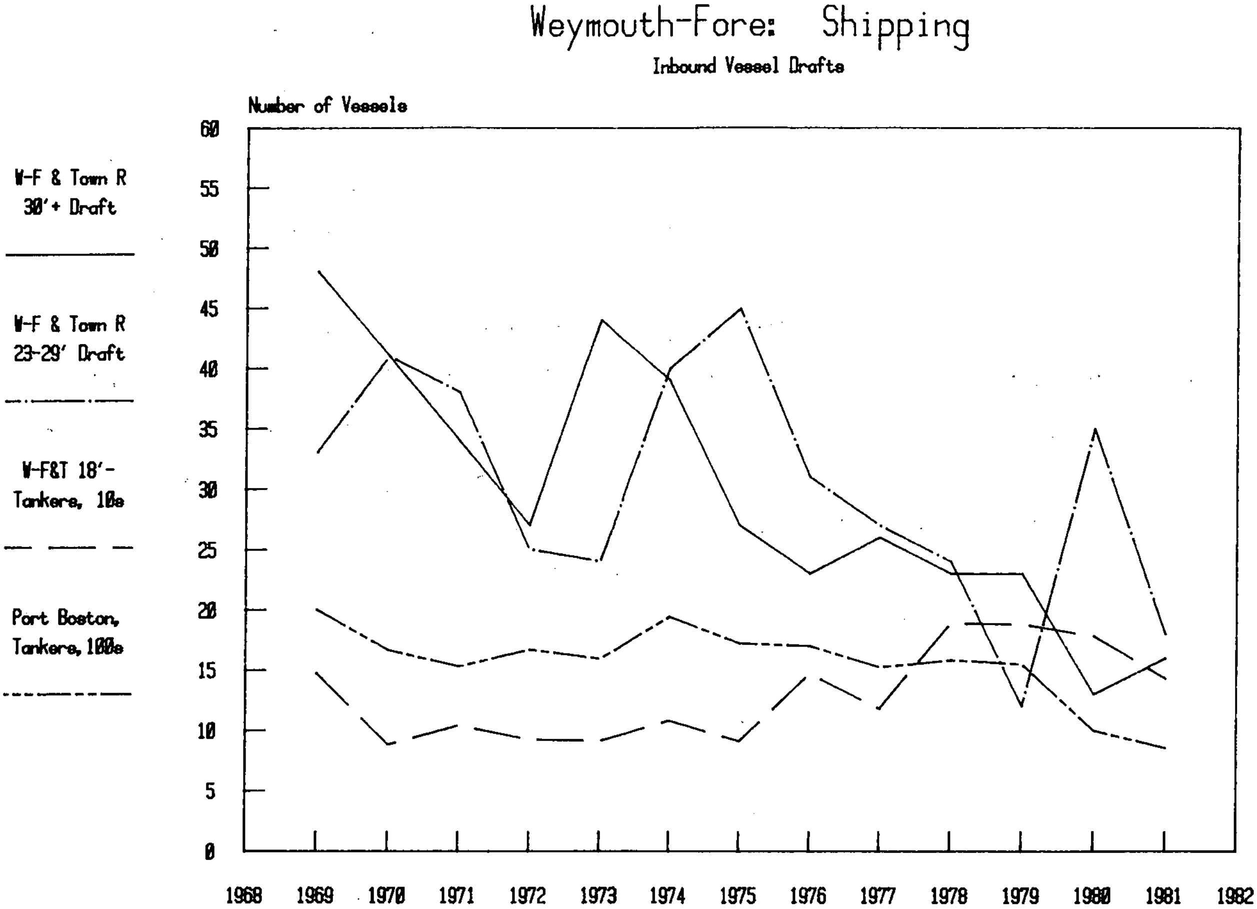

FIGURE 3 EXAMPLE FORECAST CLASSIFIED "INCONSISTENT": VESSEL DRAFTS OF INBOUND SHIPPING, WEYMOUTH-FORE AND TOWN RIVERS HARBOR, MASSACHUSETTS. FORECAST: PROJECT "WILL ALLOW DEEPER DRAFT TANKERS" (SHIFT FROM SHALLOW, LOWER EFFICIENCY TANKERS TO DEEP-DRAFT TANKERS IS THE KEY BENEFIT IN THE PROJECT B/C ANALYSIS). FIGURE PLOTS WEYMOUTH-FORE DEEP-DRAFT (30-FOOT OR GREATER DRAFT) VESSELS WITH SHALLOWER-DRAFT WEYMOUTH-FORE SHIPPING AND ALL PORT OF BOSTON TANKERS. CHANNEL WORK COMPLETED APRIL, 1977.

flatly asserted, in discussing public safety issues, that "there is no possibility that projectiles would overshoot the range".

This issue made the news immediately before our fieldwork trip. A military police contingent shot particularly ineptly in April, 1983, and peppered several Newington houses and yards with a few dozen stray 45-calibre bullets. The Newington Civic Association was up in arms, so to speak; the U.S. District Court enjoined the D.C. Department of Corrections; the local congressman attempted to impound the federal D.C. appropriations...generating five newsclips in the Washington Post and a plethora of interviewees. The forecast is classified as "inconsistent" with the actual impact.

Forecast Accuracy: Summary

Across the whole set of 239 impacts, very few forecasts in the sample are clearly inaccurate. Despite the interesting features of the Weymouth-Fore shipping and Newington firing range cases, discussed above, only 15 impacts are classified as "inconsistent" with their forecasts. Another fifth of the cases seem to be inaccurate, but unclearly so. Impacts classified as "inconsistent" are almost always in the wrong direction. If an impact is in the correct direction, but the magnitude of the impact is noticeably greater or less than predicted, the forecast is not classified "inconsistent", but as "exceeds" or "less", as shown in Table 2. In addition, 18 cases involve a forecast of some impact, but no clear impact is discernible from data showing wide pre- and post-project variance, or continuous pre/post trends.

It is particularly noteworthy that field interviews with knowledgeable informants detected only three unanticipated impacts, two of which are essentially minor, beneficial impacts. The only adverse unanticipated impact in the study, involving re-suspension of toxicants by a Tacoma Harbour dredging project, was only suggested when studies subsequent to the EIS revealed the toxicity of the harbour's sediments. Another five impacts are so understated by EIS writers that the impacts could not be considered properly anticipated. Four of these underanticipated impacts are adverse, three are so understated that they had been passed over as forecasts during the content analysis, and one involves a flat denial by the Corps of an EPA commentor's prediction of the impact that actually occurred.

On the other hand, the modal rating in the study is the most accurate classification..."close", with 65 cases, including the Paint Creek limnology and

TABLE 2 SUMMARY CLASSIFICATION OF THE MATCH BETWEEN EIS FORECASTS AND ACTUAL POST-PROJECT IMPACTS. ENTRIES ARE PRIMARY CLASSIFICATIONS ONLY. ACCURACY CLASSIFICATIONS ARE GROUPED INTO FOUR SIMILAR RANKS; MEANS IN THE LAST ROW ARE AVERAGES OF THESE ORDINAL RANKS.

	Impact Type				
Impact-Forecast Match, Primary Classification	Physiographic	Biological	Economic	Social	Totals
Match Rank = 4					
CLOSE	19	8	9	29	65
COMPLEX, but Arguably Accurate	1	0	1	2	4
Match Rank = 3					
Within RANGE of VAGUE Forecast	12	9	15	28	64
No Clear Impact, NONE Forecast	1	2	4	5	12
Accuracy INTUITIVELY OBVIOUS	1	2	0	2	5
Impact has NOT YET Occurred	1	0	3	0	4
Match Rank = 2					
COMPLEX, Essentially Inaccurate	1	1	0	0	2
Impact EXCEEDS Forecast	2	0	5	3	10
Impact LESS than Forecast	5	3	9	8	25
Impact DISPUTED	0	2	0	0	2
Impact wholly SPURIOUS	0	1	3	1	5
UNANTICIPATED, but Beneficial	1	0	0	1	2
UNDERANTICIPATED, Beneficial	0	0	1	0	1
NO Clear Impact, SOME Impact Forecast	1	3	11	3	18
Match Rank = 1					
INCONSISTENT	5	1	3	6	15
UNANTICIPATED, Adverse	1	0	0	0	1
UNDERANTICIPATED, Adverse	2	1	1	0	4
Totals	53	33	65	88	239
Mean Accuracy Ordinals	2.83	2.82	2.51	3.00	2.80

Weymouth-Fore blasting cases. An additional four cases, among them the Grand Teton wilderness example, are classified as "complex", but basically accurate in our judgement.

The second most common classification is "impact within range of a vague forecast". In fact, this group of impacts whose classification is confounded principally by forecast vagueness falls only one case short of the sample mode. Five other forecasts are quite accurate, but their impacts are logically obvious results of the execution of the proposal, such as the incidental impact of property-owner displacement by a highway, an effect accomplished as soon as the property is acquired. (Fieldwork cases include incidental-impact forecasts only if no other good forecast is available in a particular category). Another dozen cases show no clear evidence of any impact when the EIS had forecast no impact; these cases' forecasts tend to be vague, intuitively obvious, or trivial.

The accuracy classifications in Table 2 are distinct nominal categories that do not lend themselves to ready analysis. The classifications do fall into a rough hierarchy, however, as indicated by the four tanks in Table 2. Some classifications fall at the same rank because of clear conceptual similarities, such as the "exceeds" and "less" classifications. Others are grouped together because of empirical similarities observed during our audit. Others, such as the "not yet" classification, are included in relatively higher ranks than they might have been since the evaluators bear the burden of proof to demonstrate a forecast to be inaccurate. The four classification ranks form a natural ordinal index,[1] which provides a rough, but useful measure for comparing forecast accuracy.

As indicated in the last row of Table 2, physiographic and biological forecasts have almost exactly the same average accuracy as the mean for all 239 cases. Economic forecasts have a lower average accuracy, due to a fairly high number of cases in the "grey area" of the second rank classifications. This finding may be consistent with the cynical conventional wisdom about overstated economic justifications for projects, but the difference in means is fairly small compared with the standard deviation of 0.94 across all 239 cases. There are few other systematic

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1 The index takes both primary and secondary classifications into account. The case usually receives the ordinal value associated with its primary match classification. However, the case could receive an increment or decrement of one under certain conditions, chiefly, when a secondary classification is two ranks higher or lower than the primary match.

accuracy patterns among the different types of EISs in the sample. The average accuracy of the five types of projects ranges between 2.98 and 2.52. Five of the six lead agencies with more than one EIS in the sample average between 2.80 and 2.90; the sixth, the Forest Service, has the worst average, 2.40, due partly to the vagaries of its two land use planning EISs in the sample.

The most systematic difference in predictive accuracy is that mitigation promises are generally kept. The 35 mitigations in the sample have an average accuracy rating of 3.28, with 22 classified as "close"; in addition, there are fifteen secondary ratings of "mitigation done", versus only one "mitigation not done". Objectives and ordinary impacts average slightly below the sample mean (2.72 and 2.74, respectively). Controversial impacts have the lowest average accuracy, 2.29, and the best rating achieved by a controversial forecast is a "complex/arguably accurate" classification.

Conclusion

The logic of environmental assessment assumes EIS forecasts to be tolerably accurate. A "rational-comprehensive" decision-maker, in particular, must weigh a comprehensive range of consequences of each relevant alternative course of action. A rational analyst's predicted consequences must be accurate, for otherwise the decision resulting from a weighing of those consequences cannot be assumed to be optimum. Predictive accuracy also plays a role in, but is not a necessary condition of the alternate "arational" description of decision making (Lindblom, 1959; Allison, 1970). Decision-makers in political settings have different preferences and interests; so they disagree about the desirability of various potential consequences, and will in practice disagree about the cause-and-effect premises of forecasts and the non-forecasts implied by slighted consequences. In the NEPA process, this disagreement is most observable during public and interagency review of an EIS.

A major difficulty in auditing the accuracy of EISs is that their forecasts are often confoundingly vague. This study's systematic content analysis describes EIS forecasts' lack of quantification, vagueness about impacts' significance and the likelihood of occurrence, and occasional ambiguity about the direction or beneficiality of impacts. The defects of EIS forecasts will surprise few readers. Various academic observers have described these documents' flaws (Friesema and Culhane, 1976; Fairfax, 1978; Culhane, Armentano, and Friesema, 1985). Public and interagency commentors also routinely excoriate EIS writers about particular forecasts, and...of greatest practical relevance...judges have often found specific EISs to be legally inadequate.

The field teams' experience in seeking reliable data on project impacts also leads to an important conclusion. The substantial percentage of impacts for which no adequate data could be located indicates that lead agencies possess inadequate information on the consequence of their projects. If agency officers do not systematically understand the consequences of their projects, they can neither refine their predictive models for future decisions nor mitigate adverse project consequences. Indeed, this problem is most pronounced for physiographic and biological impacts...precisely the consequences that by law and common understanding the NEPA process is expected to ameliorate.

Despite these limitations, this evaluation found EIS forecasts to be not inaccurate. This double negative is used to highlight the conclusion that very few impacts in the sample are demonstrably inconsistent with EIS forecasts. Even fewer impacts are unanticipated, and there are no egregious unanticipated impacts identified during the study. On the other hand, only about a third of the forecasts in the study are tolerably accurate. The more numerous, middling forecasts are either pseudo-accurate solely by virtue of their forecasts' vagueness or somewhat inaccurate in various complicated ways. Such "grey area" forecast accuracy clearly falls short of the rationalist ideal of environmental assessment. A forecast that is either unquantifiable or quantitatively wrong is useless in calculating a project's net benefits and choosing an optimum alternative. NEPA has certainly, as Serge Taylor (1986) puts it, made U.S. federal bureaucracies think...even if the findings summarized above suggest that they could think more acutely. Similar patterns of inadequate quantification in a large sample of European, Canadian and U.S. EIAs were found by Environmental Resources Ltd. (1984). The University of Aberdeen group has also found a comparable pattern of predictive accuracy of a sample of United Kingdom EIAs, using a similar but independently developed rating scheme (Bisset, 1984).

These findings, however, should not be regarded as an unambiguous indictment of the U.S. NEPA process. An appraisal of the contents and accuracy of EISs is ultimately grounded in some model of the NEPA process as a reform of U.S. bureaucratic decision making. The proposition that EISs are "better quantitative and wrong, than qualitative and untestable" stated by Duinker (in this volume) is disputed. The federal government did not require its bureaucracies to assault the pulpwood forests of North America by writing thousands of these documents simply so that number-crunching evaluators could test nice data. The NEPA process was designed by Congress and the Council on Environmental Quality to force agencies to think about the consequences of their projects, to provide the agencies' legislative and executive overseers with alternatives, and to subject agency proposals to public and interagency review. A passage like that of the Shepard Park school enrollment forecast may pose maddening problems to a quantitative auditor. By any common sense standard, however, the observation is perfectly valid and appropriate. All EIS forecasts are not that sensible and, on the whole, I do not believe that agencies analyze consequences and consider alternatives in a comprehensive or completely objective manner. But the NEPA process has opened federal agency decision processes to some searching public and interagency scrutiny...a benefit that is more or less unrelated to the amount of quantification EIS writers choose to stuff between the covers of their documents.

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ENVIRONMENTAL IMPACT ASSESSMENT OF ABNORMAL EVENTS: A FOLLOW-UP STUDY

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Introduction

Assessing the environmental impacts of abnormal (i.e., low probability) events is a topic of much discussion in the United States. In recent years, federal agencies and courts have attempted to clarify the need for and content of such analyses in EIA documents. None of these efforts, however, have attempted to shed light on this subject by conducting a follow-up study that compares actual impacts from abnormal operational events at facilities with those postulated in impact analyses.

In the United States, the National Environmental Policy Act (NEPA), is the principal body of federal legislation governing the preparation of EIA documents. NEPA requires federal agencies to consider environmental factors in their decision making process. In November 1978 the President's Council on Environmental Quality (CEQ) promulgated regulations that are binding on federal agencies for the implementation of NEPA (40 CFR 1500-1508).

In 1502.22, the CEQ outlines procedures by which federal agencies must deal with the required discussion of significant adverse impacts in an Environmental Impact Statement (EIS) when essential information is missing or when analytical tools are not developed. In such situations, the potential adverse impacts in the "worst-case" must be discussed and analyzed. If an agency proceeds with the action of interest, then it must, under current regulations, include a worst-case analysis and an estimate of the probability of the worst-case occurring. CEQ (1983, 1984) has issued and withdrawn guidance to federal agencies regarding worst-case analysis; and recently, proposed changes to the regulations for worst-case analysis (CEQ, 1985). The Council proposes to eliminate the concept of worst-case analysis in situations where information essential to an understanding of significant adverse environmental impacts is missing or incomplete. Instead, the Council will require analyses of low probability, high consequence impacts when the postulated occurrence of said impacts is based on credible science rather than speculation.

Low probability, high consequence impacts can result from normal operations of a facility during a perturbation in the sensitivity of the existing environment to impacts, or from abnormal operations that produce environmental releases or discharges of exceptionally high magnitude. Given the recent increase in public interest in the impacts of abnormal events in the wake of the Bhopal incident, this paper is concerned with the latter situation. In the past, and under current CEQ regulations, worst-case analyses of impacts from abnormal events have been triggered by a lack of key information. This, in turn, has lead to speculation in some EIA documents on the type of event and associated environmental releases that could occur for a facility of interest. NEPA and CEQ regulations do not specify the types of abnormal events (i.e., specific probabilities of occurrence) that must be considered in EIA documents. Rather they outline procedures for assessing the direct, indirect and cumulative impacts of reasonable alternatives. The criterion of reasonableness influences the selection of the types of events to be considered.

Worst-case accident analysis has been addressed by several recent appellate court decisions. Ramifications of three of the key decisions are as follows:

1) an agency may not exclude a worst-case analysis from a NEPA document simply because the analysis deals with an event that has a low probability of occurrence;[1]
2) the worst-case analysis requirements in 40 CFR 1502.22 apply to an Environmental Assessment (EA) even though the pertinent regulation refers only to an EIS; [2]and
3) an agency may issue a Finding of No Significant Impact based on an EA that identified a significant impact from a remote event.[3]

In light of changes of guidance, proposed changes in regulations, and recent court decisions, it is of interest to conduct a follow-up study that compares predicted vs actual environmental impacts of abnormal events at selected facilities, and that provides information relevant to pressing questions in this general area. Were reasonable events analyzed? Were impacts based on conjecture or credible science? Were catastrophic impacts identified in EIA documents? Did catastrophic impacts, not identified, actually occur? Answers to these questions will help determine the usefulness of analyzing low probability, high consequence impacts in EIA documents, and will help determine whether or not proposed regulatory changes are appropriate.

Data and Analysis

Approach

Two principal criteria were used in selecting projects for this analysis: project diversity and data availability. On the first count, it was felt that a broader perspective could be obtained by examining a range of technologies and projects. The second criterion, data availability, was by far the more important of the two and was the limiting factor in selecting projects for review. In terms of data availability, a project was required to meet three conditions: existence of EIA documentation, occurrence of one or more abnormal events, and performance and reporting of post-event impact monitoring. It was also of interest to examine EIA documents prepared at various times throughout the history of NEPA.

Description of Case Studies

Four case studies were identified for follow-up evaluation using the criteria identified above. These case studies represent a broad range of energy technologies and all have environmental documentation associated with the project development. Each case study is associated with an operational abnormal event and subsequent studies that evaluated the effects of the event.

West Hackberry Strategic Petroleum Reserve Site

The West Hackberry Strategic Petroleum Reserve (SPR) site is a crude oil storage facility with a capacity of 60 million barrels located in Cameron Parish, Louisiana. The purpose of the facility is to store crude oil to mitigate the economic impacts of any future disruption of petroleum imports.

Documentation for the project consists of an Environmental Impact Statement prepared prior to construction and a Supplemental Environmental Impact Statement that was subsequently prepared to reflect changes in the oil distribution system and the resulting changes in the anticipated impacts (U.S. Department of Energy, 1977a, b). The issue of abnormal events from facility operation was addressed in both Environmental Impact Statements. Specific events that were considered included pipeline accidents, oil spills during marine transportation, fires, explosions, accidental injury to personnel, cavity collapse, and natural disasters. The analysis of fires and explosions is of interest to this study. In the original EIS, the possibility of major fires or explosions was associated with high pressure operations or blowouts. The principal impact was postulated to be a temporary release of smoke to the atmosphere. In the supplemental EIS, it was estimated that vapors from spills of unweathered crude oil could be ignited if ignition sources were nearby, but that the offsite ignition of vapors would probably not occur for spills of 1000 barrels (bbl) or less. Based on experience at oil handling facilities, only localized fires were expected to occur. The impacts associated with a crude oil fire were assessed to be localized destruction of vegetation and the release of smoke and other combustion products to the atmosphere.

On September 21, 1978, an oil workover rig was in the process of removing brine piping from a well when a packer slipped up the piping and allowed oil to flow to the surface. Vapors from the oil ignited, resulting in the death of a worker, serious injury to another worker, equipment destruction, and the release of 72,000 bbl of crude oil. The fire burned for six days before the well could be sealed and the fire extinguished. About 52,000 bbl of oil were eventually recovered, including 32,000 bbl recovered from Black Lake, which is adjacent to the site. The remaining 20,000 bbl were either burned or irrecoverably attached to the soil and debris. The recovered oil was reinjected into the salt cavern. The contaminated soil and debris were removed for treatment and disposal. The explosion, fire and spill were declared a major pollution incident. Cleanup of the spilled oil lasted for two weeks with an associated cost of approximately $20 million.

Monitoring was conducted in detail for one year after the event. The oil spill remained in the marsh sediments west of the site throughout the monitoring period and was expected to persist for several years. No adverse impacts on animals in the marsh were detected. Adverse impacts to marsh vegetation were detected and were associated with the accelerated deterioration of the marsh habitat. Since the site area had been extensively impacted by previous oil production activities, some of the impacts may have been difficult to detect. Based on monitoring results, products of combustion distributed by the fire plume were found to consist largely of chemically stable compounds, rather than more physiologically dangerous compounds such as benzopyrene. Remote sensing of stress in vegetation indicated that stress was evident immediately after the fire, but had disappeared by the end of the one year survey (U.S. Department of Energy, 1980a).

Three Mile Island

The Three Mile Island (TMI) Nuclear Station Unit 2 is an 880 MW pressurized water reactor located 10 miles southeast of Harrisburg, Pennsylvania. The plant was announced on February 3, 1967, granted a construction permit on November 4, 1969, granted an operating license on February 8, 1978, and went into commercial operation shortly thereafter. Commercial operation was suspended after a serious accident occurred on March 28, 1979. The plant is located on a 200 acre tract of land on the 427 acre Three Mile Island in the Susquehanna River. The nearest towns are Middleton, located three miles to the north, and Goldsboro, located 1.25 miles to the west. During operation the plant provided power to the southeastern Pennsylvania and New Jersey service area.

A variety of EIA documents were prepared for TMI, ranging from the initial "Environmental Report, Operating License Stage" submitted by the project sponsors (Metropolitan Edison Company, Pennsylvania Electric Company, and Jersey Central Power and Light Company) in October 1970 to the U.S. Atomic Energy Commission (AEC), to the "Final Supplement to the Final EIS" issued in December 1976 by the U.S. Nuclear Regulation Commission (NRC) prior to issuing the operating license for Unit 2. Impacts from plant operation were considered throughout the environmental review process and were updated as new information became available (U.S. Atomic Energy Commission, 1972). The analysis contained in the Final Supplement to the Final Environmental Statement considered impacts resulting from abnormal plant operations and from transportation of nuclear materials. Potential radiological doses to the nearby population from a large break, loss-of-coolant accident were estimated by the NRC to be about 1100 man-rem (within a 50 mile radius). These estimates were considered to be realistic assessments of possible events. More conservative evaluations were incorporated in the safety analysis of the project (U.S. Nuclear Regulatory Commission, 1976).

The principal abnormal event that occurred at TMI was a loss of coolant with attendant failures. About 4 a.m. on March 28, 1979, a loss of feedwater to the steam generators resulted in a shutdown of plant operations, and subsequently reduced the removal of heat from the reactor coolant system. Initially, the reactor protection systems performed as designed. Forty seconds afterwards, water levels in the steam generators had dropped to the point that an emergency feedwater injection was necessary. Erroneously closed valves prevented this injection from occurring, resulting in the opening of the pilot operated relief valve (PORV) to reduce internal pressure. This valve inadvertently remained open resulting in the further loss of reactor coolant. High pressure injection pumps were automatically turned on to provide cooling water but were turned off by the operators resulting in continued loss of coolant. After 2 hours and 20 minutes the PORV was closed. High pressure injection of cooling water was resumed after 3 hours and 40 minutes. Within 100 minutes these pumps were turned off by the operators because of high vibration and fear of damage to the pumps. Subsequent hydrogen generation resulted in loss of control of cooling system circulation. The low pressure decay heat removal system and the PORV were then used to relieve excess pressure and vent hydrogen to the containment building. Another high pressure injection was made which allowed circulation within one steam generator to be established. A hydrogen explosion occurred within the containment building at 9 hours and 50 minutes. High levels of hydrogen persisted in the reactor over the next seven days as efforts continued to establish coolant circulation within the reactor. With the venting of hydrogen to containment, coolant circulation was restored and the decay heat removal system allowed for cold shutdown of the plant on April 27, 1979.

During the accident, coolant was piped to the reactor coolant drain tank. This tank developed a ruptured pressure disk which allowed the coolant to drain to the reactor building sump. Some of this coolant was pumped to the auxiliary building where it spilled onto the floor from a tank with a previously ruptured pressure disk. After core damage occurred, radioactive coolant was pumped out of the reactor by the letdown line of the makeup system. This coolant was highly radioactive and resulted in spills within the auxiliary building and fuel handling building that contaminated the previously spilled coolant. The spills of coolant within the fuel handling building and the auxiliary building resulted in the release of large quantities of gases through the plant vent system with a total radioactivity content of 2.5 million curies.

Prior to the accident at Three Mile Island, extensive monitoring equipment was already in place as part of the conditions on the operating license for the plant (U.S. Nuclear Regulatory Commission, 1976). Both a radiological environmental and occupational monitoring program were in place. On-site monitoring determined that releases through the liquid treatment system were nominal and were well within operating criteria. Off-site monitoring was directed towards detecting releases, build up of radionuclides, and any changes in gamma radiation levels. Fish and sediment samples were taken semi-annually; air particulates, milk, and precipitation were sampled monthly; green leafy vegetables were sampled annually; and gaseous iodine was sampled weekly. Direct radiation monitors (Thermoluminescent Detectors (TLDs)) were placed quarterly at 20 locations. In response to the accident, thousands of environmental samples were collected by Metropolitan Edison, the Commonwealth of Pennsylvania, and agencies of the Federal government (U.S. Nuclear Regulatory Commission, 1980). Samples were collected from March 28 to April 16, 1979 from water, air, milk, vegetation, soil and foodstuffs. These samples confirmed that the releases from the accident were limited to noble gases and a small quantity of radioiodines. As a result of these data, population doses were estimated by several groups and ranged from 300 person-rem to 3500 person-rem, with an average estimate of 1900 person-rem. The dose to the maximum exposed individual off-site was estimated by all groups to be less than 100 mrem. The interpretation of these data and the associated dose estimates has been controversial; however, most studies which have been released to date suggest that no long term or short term effects from the event are to be expected.

Trans-Alaska Pipeline

The Trans-Alaska pipeline is an 800-mile long, 48-inch diameter crude oil pipeline. It took about 38 months to construct. In July 1977, the pipeline began operation, delivering crude oil from the Kuparuk and Prudhoe Bay oil fields to the Valdez Marine Terminal.

The principal abnormal events addressed in the EIA document are crude oil spills and accidental releases to the environment. The impacts of crude oil releases are discussed in light of the terrestrial, aquatic and marine environments potentially impacted by the pipeline. The EIA document assumed that a spill of 25,000 bbl in the summer would cover more than 6.6 acres. The principal predicted impact of spills on land was the death of plants that became coated by the oil. Death of vegetation in areas underlain by ice-rich permafrost would result in permafrost degradation and severe soil erosion. Terrestrial oil spills were not expected to have an important influence on large mammals. No other impacts were identified from terrestrial oil spills in the EIS (U.S. Department of Interior, 1972).

A number of releases of petroleum to the environment have occurred from the Trans-Alaska pipeline. On July 19, 1977, over 2,000 bbl of crude oil were spilled at Valve 7 on the Coastal Plain north of Franklin Bluffs and at Steele Creek in the

Goreal Forest south of Fairbanks. Cleanup efforts used primarily hand labour. Although the cleanup efforts helped remove oil from the soil, they also produced one of the major impacts from the Valve 7 spill (Johnson, 1981). Repeated trampling by the workers of the oil-saturated soil degraded soil structure. On February 2, 1978, a spill of about 12,000 bbl of crude oil occurred at Steele Creek following a sabotage explosion. The oil sprayed or flowed out into surrounding vegetation. A third spill with associated terrestrial vegetation impacts occurred on January 1, 1981 at Check Valve 23, which is located about 125 miles south of Prudhoe Bay. Approximately 1,500 bbl were spilled, and an estimated 800 bbl were recovered during the initial cleanup. The remaining 700 bbl spread over approximately 3/4 acre immediately downslope from the check valve which produced an estimated oil loading of about 1000 bbl/acre (Brendel, 1985).

Spill impact monitoring generally consisted of visual inspections to ascertain areal coverage, depth of soil penetration, and vegetative regrowth. In the Valve 7 spill, site inspection in early August 1977 found that vegetative cover increased with distance from the valve. At a subsequent visit in August 1978, after attempts had been made to reestablish vegetative cover within the heavily impacted area, very little regrowth was observed within the oil impacted area adjacent to the workpad, whereas at a distance of 55 yds., little visible effect on the upright vegetation was observed. For the Steele Creek spill, a site inspection in September 1978 noted that some regrowth of native grasses had occurred within the burned zone. Post-accident evaluations of the impacts of these two events suggest that a large crude oil spill may not kill all vegetation, even in heavily saturated areas (Johnson, 1981). For the Check Valve 23 spill, post-accident monitoring of impacts suggested that vegetation was killed in the spill area. In 1982, the 3/4 acre spill site showed no significant regrowth of vegetation. Most of the heavily oiled area remained black and unvegetated in early summer of 1982 (1 1/2 years after the spill). Mats of hard tar had begun to form in the bermed area. A subsequent vegetation study reestablished vegetation (Brendel, 1985).

Dow Parcperdue Geopressure Design Well

The Dow Parcperdue geopressure design well project was located in Vermilion Parish, Louisiana, about 50 miles southwest of Lake Charles, Louisiana. Site preparation on the 37.5 acre tract began in January 1981. The production well was completed in summer 1981 at a depth of about 13,350 feet, and preliminary flow testing began in October 1981. The injection well was drilled in early 1982 at a depth of about 5,000 feet. The Dow well typically produced about 10,000 bbl of brine per day and about 150,000 ft^3 of gas per day. In February 1983, the well ceased operation; by April 1983, the wells were plugged and abandoned. Project decommissioning and site restoration were completed in May 1983.

Impacts to soils, surface water, groundwater, land use and ecology from abnormal events were identified and discussed in the project's EIA documentation (U.S. Department of Energy, 1980b). The discussion of leaks from mud and brine pits is of principal interest. Spills or leaks in the mud pit liner were identified as being capable of contaminating on-site soils, with the amount of contamination being directly proportional to the magnitude and duration of the accidental release. As a worst-case, it was stated that a release could contaminate the soil to the extent that it could not support vegetation. Under land use, the impacts of a brine spill on agricultural land were addressed. Hindered productivity due to soil salinization was of principal concern. Ecological impacts received the most discussion. It was postulated that minor leaks and spills would be retained within the ring dike, and that resultant impacts from such events should be limited to the injury or death of a few of the small number of plants and animals remaining in the less-disturbed areas of the dike.

During the life of the Dow project, principal abnormal events consisted of leaks from a drilling mud pit and a brine storage pit. In August 1982, during an on-site NEPA follow-up investigation, it was determined that a polyethylene liner in the mud pit, which was used to store water-based drilling mud, drilling tailings and fresh water, had been torn for about 12 months, thus allowing chemical constituents in the mud to contaminate soil and groundwater (Reed et al, 1983). A second leak occurred on November 5, 1982, when the 30,000 bbl brine pit liner split, thus allowing brine to escape.

Routine surface and groundwater monitoring conducted throughout the period of the leaking mud pit showed no apparent impacts from constitutents likely to be in the mud. Furthermore, aquatic life was sustained in the pit, thus further reducing the likelihood of significant adverse impacts. As a result of the brine leak, a 4-month groundwater and surface water monitoring program was initiated. Data collected on November 15, 1982 indicated conductivity, salinity, and chloride values were substantially above background levels (Reed, 1985). Data collected at the same wells and the surface water stations in February 1983 showed that chloride levels had decreased over time, and were at or below background levels. As a part of decommissioning of the Dow well, soil analyses in the pit and around its north levee indicated contamination; the entire north levee and about 1 foot of soil on the bottom of the pit were removed for off-site disposal.

Results

This section presents the results of comparing predicted vs actual impacts at the four case studies, and serves as a basis for drawing conclusions on worst-case analysis.

West Hackberry Strategic Petroleum Reserve Site

Comparisons of impacts from the fire and spill at the West Hackberry SPR facility with those postulated in the EIS do not provide a favorable comparison. The emphasis in the EIS was placed on oil spills during oil transportation. Minor emphasis was placed on fire and explosions. The postulated events associated with fires and explosions were drastic underestimates of the actual events. To some extent, this can be related to the fact that the EIS documents were prepared prior to the issuance of the CEQ regulations requiring worst-case analyses in the absence of key information. Another contributing factor is the comparative unique nature of the event that occurred at the West Hackberry facility. No satisfactory explanation has yet been offered to explain why the packer slipped in the brine piping. The analysis contained in the Supplemental EIS does correctly identify the inflammable nature of spilled crude oil, which is in contrast to the original EIS. However, both EISs grossly underestimate the magnitude of a potential oil spill associated with a fire and explosion. As a result, neither analysis leads to the conclusion that the likely impact from a fire or explosion would be the degradation of marsh habitat. This void in the analysis is even more troublesome given the fact that the site area had already been significantly impacted by oil spills from other operations.

The analysis of abnormal events in the EIS concentrates on events that have not occurred as yet. Few conclusions can be drawn from this observation beyond noting that an apparent lack of balance exists in the analysis. The discussion of the accidental injury to workers concluded that the risk of occupational injury was very small and was not considered further. Obviously, this conclusion is also suspect, given that one death and a serious injury resulted from the accident.

Three Mile Island

Monitoring and data analysis of the event at Three Mile Island generally supports the analysis contained in the Final Supplement to the Environmental Statement. The event could be fairly described as a large loss of coolant with additional contributing failures. Using a realistic analysis, the population dose estimated in the Environmental Statement of 1100 man-rem for a large loss-of-coolant event without additional failures agrees with the estimates calculated from the monitoring data from the Three Mile Island accident (average of 1900 man-rem). The similarity of the predicted impact with the observed impact is indeed remarkable considering the rather unusual circumstances surrounding the event. The only doubt that arises in the review of the analysis in the Environmental Statement is the stated low probability of occurrence. Regulatory actions since the event at TMI have been directed towards making a recurrence of the events at TMI less likely and more in step with the expectation that these types of events are of low probability.

The events at Three Mile Island corresponded closely to the realistic analysis contained in the Environmental Statement. Had a worst-case analysis been incorporated into the document, a more rigorous monitoring program may have resulted. With a more rigorous monitoring program, the capability of determining the effects of the accident would have been greatly improved. Uncertainties related to the accuracy and completeness of the data collected during the accident have dominated the debate surrounding the consequences of the accident. With the benefit of hindsight, a more comprehensive data base would have been worth an increase in the costs associated with the monitoring. This observation parallels the findings and recommendations of the U.S. Nuclear Regulatory Commission Group (1980). They found that the TLD monitors placed by Metropolitan Edison as part of its environmental radiation monitoring for normal operation were adequate for characterizing the radiation levels attributable to the accident and the supplemental TLD monitors placed after the accident were of limited use. They recommended that the Commission reevaluate its requirements for environmental radiation monitoring to ensure that monitoring of normal and accident conditions was at least as adequate as the monitoring that occurred in response to the accident. The recommended reevaluation was to include the number and location of TLD monitors, airborne activity monitoring stations and real time instrumentation for monitoring radiation in the site environs.

Trans-Alaska Pipeline

Post accident monitoring of impacts from crude oil releases from the Trans-Alaska pipeline in general support the impact assessment done in the EIS. In the cases of the Valve 7 and Steele Creek spills, it appears that the EIS overestimated impacts by stating that vegetation would be killed by a spill. In these two cases, vegetative regrowth was observed after the spill following cleanup of the spilled area. Since the EIS did not discuss any possible beneficial effects from spill cleanup, the overestimate of impacts may be due to the assumption of a direct oil spill with no mitigation. In the case of Check Valve 23, the impacts appeared to generally agree with impacts postulated in the EIS. In this case, even after spill cleanup, vegetative recovery did not readily occur. In one case the attempted oil spill cleanup efforts did as much, if not more, damage to the tundra than the spill itself. The EIS did not anticipate damage from attempted measures to mitigate oil spill impacts.

In comparing predicted vs actual impacts from crude oil releases at the Trans-Alaska pipeline, it appears that the EIA document included the most likely event (oil spills on land), but devoted more in-depth analysis to spills from tankers in port. The analyses of oil spills on tundra identified no unique aspects of the event that would present special problems for mitigating impacts to terrestrial vegetation. No monitoring requirements were identified in the EIS to assist in reducing the environmental impact of a land-based crude oil spill. The land based spills that have been reported were of smaller size and covered less acreage than the values given in the EIS. The oil loading for one actual spill for which data are available (1000 bbl/acre for Check Valve 23) was considerably less than the oil loading postulated in the EIS (about 3500 bbl/acre). However, larger spills and greater impacts are still possible.

Dow-Parcperdue Geopressure Design Well

A comparison of actual impacts from events at the geopressured well with those predicted indicates that in general the anticipated worst-case impacts did not materialize, and that actual impacts from abnormal events were of lesser magnitude and shorter duration. This is primarily due to a well-run project during normal operation and to effective response during abnormal events. The worst-case event postulated in the EIA documents - a well blowout at 200% of design flow rate - did not occur. No blowouts occurred during the project life; the use of blowout prevention equipment on the well was confirmed during an August 1982 NEPA verification inspection (Reed et al, 1983).

Predicted impacts from leaks and spills generally agreed with actual impacts. The EA slightly overestimated the magnitude of the impact from a leak in the mud pit. Even though the mud pit liner had been torn for about 12 months, no serious soil contamination occurred. The principal soil impact of concern from drilling mud release was that the soil would be unable to support vegetation. At the Dow well, the mud not only did not prevent vegetative growth, but it was actually used as a soil amendment during project decommissioning. For the brine leak, actual soil impacts from the brine pit leak confirm the concerns of reduced soil productivity addressed in the EA. After the brine contaminated soil test results were reviewed, the contaminated soil was removed for off-site disposal, and replaced with topsoil. Since the site now supports vegetation, these mitigative measures appear to have had the desired effect.

Discussion

Drawing conclusions of general value to impact assessment for abnormal events at many projects is difficult with a limited sample size of four case studies. However, a number of conclusions can be drawn that are relevant to the topic of impact assessment in general.

Novel Technologies

The results indicate that the more novel or unique a given technology is to a given area, the greater the need for a well-considered analysis of the impact of abnormal events.

In the case of the West Hackberry project, impacts were minimized by the quick response of the project teams to the explosion, fire and spill, and by the familiarity of the response team with this type of event. As a result, a situation that could have been catastrophic was reduced to the level of a major pollution accident. If the existing experience with the handling of crude oil were not so well developed as to require oil spill prevention plans, as required by the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 300), the level of environmental impact would have been drastically increased.

As a result of their limited operating experience, the TMI project sponsors were not able to foresee the nature of the abnormal event. They did not identify a scenario in the Environmental Statement that had the gravity or complexity of the event that occurred. This resulted in a monitoring program that was not as aggressive as hindsight would suggest or a level of awareness more in step with the needs of nuclear technology. A more conservative basis for decision making may have reduced the consequences of the event by requiring monitoring and mitigation measures similar to those that have been imposed on the nuclear industry since the TMI event.

In the case of the Dow Parcperdue project, location of the site exerted a similar beneficial effect on minimizing impacts. Although the project per se was unique to the area (for that matter, to any area), technologically it was similar to an oil well operation. The fact that it was operated by people with experience in the petrochemical industry in an area that is familiar with the technology was the principal reason that the impacts from the leaks that did occur were confined to temporary water quality effects in the project vicinity.

In the case of the Trans-Alaska pipeline, a lack of familiarity with crude oil spill cleanup on tundra contributed to adverse impacts from spills; thus, the uniqueness of the project to the area led to improper spill cleanup attempts that produced their own adverse impacts. Perhaps the project would have benefited from a more rigorous analysis of the impacts of land-based crude oil spills and requisite cleanup measures.

Favorable site location and a known technology can contribute to mitigation of impacts from abnormal events, regardless of the analyses contained in EIA documents for projects. For technologies without a long history of operation, the role of analyzing abnormal events in EIA documents is much more important.

Abnormal Event

The results of the four case studies indicate that some EIA documents mentioned the appropriate abnormal event in a list of events that could occur, but then focused their analyses of impacts on events that did not transpire. EIA documents for some of the case studies identified reasonable abnormal events (e.g., crude oil pipeline breaks and leaks in mud pit and brine pit liners) for the technology of interest. Others discussed and analyzed events that did not occur, and did not address catastrophic impacts that did occur. Furthermore, the analyses evaluated show a lack of uniformity in comprehensiveness/completeness, accuracy/skill and emphasis. This suggests that perhaps impact analysis could be improved by using risk assessment to identify those events that could reasonably occur during the project lifetime. Given the reasonably foreseeable events, impacts could then be assessed.

Operational Plans

Impacts from abnormal events could be more effectively dealt with by incorporating EIA documents into project operation plans and by using the documents for developing response plans for accidents identified. Familiarity with the potential impacts that could result from an abnormal event would help project designers and facility managers design and operate projects in a manner that would minimize the changes of the event occurring and would also help in responding for cleanup and mitigation. In the case of the Dow Parcperdue project, the facility team was familiar with impact monitoring and mitigation needs (as determined in an on-site NEPA follow-up study), and thus was able to respond quickly to a brine release from the project, thereby minimizing adverse impacts. Examining predicted vs actual impacts for accidents at TMI and the Trans-Alaska Pipeline indicates that impacts with grave consequences should trigger aggressive monitoring programs such that the gravity of a particular accident event can be determined and that appropriate corrective actions can be quickly implemented to limit consequences. Spill response and cleanup for crude oil releases from the Trans-Alaska Pipeline could have been improved by enhanced flow monitoring and leak detection equipment, and by a more detailed understanding of the nature of oil spills in tundra environments. A more aggressive radiation level monitoring program at TMI might have identified attendant problems contributing to the loss of coolant accident, thus helping in earlier identification of the problem and implementation of corrective action. The efforts associated with EIA document preparation would benefit from being conducted in conjunction with Safety Analysis Reports prepared for certain technologies (such as nuclear).

It is important to recognize that EIA documents need not be confined to planning and decision making at the beginning of a project, and that they can be very helpful in project implementation and operation. Knowledge of what events could occur, and their associated impacts, would help design mitigation measures and monitoring programs for a given project. While these types of analyses are typical on nuclear projects, it is important to include these events in all EIA documents because typically they are not covered by permit conditions or other requirements enforced by regulatory agencies in the United States.

Regulatory Requirements

Current regulatory requirements under which many abnormal events are assessed can lead to the analysis of inappropriate events and to the speculation of worst-case impacts. It is important to recognize that the regulations are concerned with identifying a worst-case impact from a reasonable, albeit low probability event. They do not require formulation of a worst-case event or scenario that is remote to the extent of being speculative. Perhaps it is appropriate to develop a probability criterion for guiding the selection of low probability events for analysis conducted in accordance with regulations. The proposed changes to 40 CFR 1502.22 are an improvement over existing regulations because they will place the assessment of low-probability, high consequence impacts on a firmer scientific base, and thus should result in more useful EIA documents for decision makers, and ultimately, better decisions.

Conclusions

Even though the case studies reviewed represent a variety of technologies and locations, and reflect EIA documentation prepared at different times in the history of environmental impact assessment in the U.S., the following conclusions can be drawn:

1. For specific projects, analyses of abnormal events are important in characterizing the spectrum of potential impacts postulated for the life of a project, especially where information is lacking on the environmental releases from abnormal events associated with a particular technology.
2. Analyses of abnormal events are meaningful tools in helping to design mitigation measures and monitoring systems that will encompass all reasonably foreseeable impacts from a particular project.
3. In light of the broad goals of NEPA, analysis of abnormal events can be used to rationally examine major projects and to provide information to federal decision makers that will help protect the quality of the human environment, provided that the postulated events are reasonable and that the impact assessment is based on credible science rather than speculation.

4. On a generic level, analysis of abnormal events is an effective technology assessment tool for novel technologies or for existing technologies applied to new areas.

FOOTNOTES

1. Sierra Club v. Sigler, 532 F. Supp. 1222 (S.D. Tex. 1982).

2. Southern Oregon Citizens Against Toxic Sprays v. Watt, 720 F. 2d 1475 (9th Cir. 1983).

3. The City of New York and the State of New York v. The United States Department of Transportation and Commonwealth Edison Co., 715 F. 2d 732, 2nd Cir. 1983.

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FORECASTING ENVIRONMENTAL IMPACTS: BETTER QUANTITATIVE AND WRONG THAN QUALITATIVE AND UNTESTABLE!

Peter N. Duinker

Introduction

Environmental impact assessment (EIA) is undertaken partly to improve the information base for development decision-making. Before EIA was widely practiced, development options were compared mostly in terms of direct financial costs and technical feasibility, probably along with some implicit feel on the part of the decision-makers for the broader implications for the natural and social environments. EIA was developed to try to ensure that the latter considerations received the same systematic treatment as financial costs and benefits.

Monetary costs and benefits are forecast and measured in precise terms (e.g., in terms of the dollar). Thus, decision-makers can tell the direct dollar benefits and cost that are expected from development options. No decision-maker would settle for qualitative economic statements from analysts, such as "option A is expected to cost only slightly more than option B, but revenues will be leaps and bounds more!".

Note that economic analysts have always stated their cost and benefit forecasts in quantitative terms, despite the difficulties inherent in dealing with such uncertainties as future interest rates, value of the dollar on international markets, and human behaviour in relation to demand of goods. Cost and benefit forecasts are still given in quantitative terms, despite the great likelihood of being wrong. There are numerous examples of underestimation of costs of a large development (e.g., Lapreau I Nuclear Generating Station) or overestimation of demand of products (e.g., Ontario Hydro's electricity demand forecasts from Cape Breton's manufacturing facilities).

Determining whether monetary forecasts are wrong is easy - just compare the forecast with the measurement of dollars of cost or of benefit. Being wrong is seldom easy to take, but at least knowing that one is wrong is a beginning step in the learning process (Baskerville, 1985).

The foregoing in no way attempts to suggest that environmental impact analysts should adopt the forecasting models that economists have used, but simply that environmental impacts can and should be forecast quantitatively. Quantitative forecasts for biological and physical systems in EIA, like economic forecasts, will likely turn out to be wrong! This paper, however, asserts that it is better to forecast environmental impacts quantitatively and risk being wrong, than to forecast them qualitatively and thus render most of them untestable.

The rationale for this position is as follows:

(a) decision-makers are more likely to pay attention to and use environmental impact forecasts when they are stated quantitatively and are measurable; and

(b) decision-makers and impact analysts cannot learn much about the system for which decisions are being made unless they can detect error, and the detection of error is much easier for quantified forecasts than for qualitative forecasts.

The following discussions of these points will be illuminated with the examples of impacts of forest harvesting in New Brunswick on deer.

A Seat at the Decision Table

Development decision-makers want to compare options in terms of their expected performance across important system indicators. This means that a set of system performance indicators needs to be chosen, along with explicit measures, and that forecasts need to be made for each indicator for each option. When this is done, a decision-maker can see in quantitative terms the trade-offs expected in choosing one option over another.

When indicators are quantitatively forecast, they can be treated either as constraints or objectives. As constraints, the decision-maker can choose (or be given, as appropriate) the performance levels to be met, and thus define a feasible option space within which to search for a suitable option according to the remaining indicators. Alternatively, as objectives, the indicator forecasts can show performance of any option towards meeting an objective. If an indicator is not quantitatively forecast, but only qualitatively (e.g., better or worse, higher or lower, long-term or short-term), then it cannot be used either as a constraint or an objective. What is often done in EIA when indicator forecasts are qualitative is apply a constraint on a measurable variable or facet of the system which is believed to directly link a development action and the indicator of interest. Here we assume (implicitly or explicitly) that satisfaction of that constraint will prevent undesirable levels (as might be caused by the action under investigation) in the real indicator of interest. This is not really an effective way to get environmental concerns well looked after in development decision-making.

Let us explore these notions using the example of the effects of crown-forest cutting plans on deer. Conventional wisdom holds that white-tailed deer in New Brunswick require winter cover in the form of mature spruce/fir stands. Such stands provide shelter from open sky and wind, and snow accumulations are usually lower than in openings and hardwood stands. Not all seemingly eligible stands are occupied by deer each winter, and those that are occupied are frequented by the same deer year after year, indicating an habituation among animals for a specific wintering area. Groups of mature spruce/fir stands that are habitually occupied by deer in winter are called deer wintering areas (DWAs).

The harvesting of stands within a forest can have two implications for deer: (a) it could liquidate portions or all of a DWA; and/or (b) it could provide a new opening rich in non-winter forage. Forest companies that produce plans to harvest stands know fairly precisely what costs are involved and what revenues can be expected for alternative harvest plans. They forecast quantitatively the amount of wood of specific types (e.g., pulpwood or sawlogs) they expect to harvest, and they forecast quantitatively the expected yield over time of the subsequent crop on that cutover ground given certain silvicultural treatments. They do this not only for a specific stand, but for all stands in the forest under their management. They have physical control over amount of yield harvested per unit time, piece size and species within that yield, specific locations and timings of harvest, and subsequent silvicultural treatment of harvested areas to regenerate the stands. Of course, these controls can only be exercised within the biological constraints of the forested real estate under management.

For any particular set of harvest and silvicultural plans, the companies forecast the costs and revenues expected. Currently, neither the companies nor the Crown (i.e., the provincial government, whose mandate includes management of habitat for wildlife) forecast the levels of deer populations expected with each alternative set of harvest and silviculture plans. Instead, the Crown has placed constraints on the way in which the companies are permitted to design harvest plans. For example, 60 to 70% of a DWA must be maintained in cover-type stands. Cuts in DWAs cannot exceed 10 ha in size. Cutting in DWAs must be done in fall or winter. And so on. In developing these constraints, the Crown has assumed that "DWAs, as they now exist in terms of numbers, quality, distribution and area, are required to maintain deer numbers" (New Brunswick Department of Natural Resources, 1984).

Thus, constraints have been applied on forest harvesting possibilities in an effort to mitigate potential impacts on deer (i.e., to maintain deer numbers). The forest companies can meet these constraints (and they are required to do so by contract), and they can show the increased costs and/or lost revenues of meeting them. But because no one has yet drawn explicit quantitative links between winter cover habitat and deer populations, no-one has a good idea whether the deer actually benefit from applying the constraints. Because the companies incur either increased costs or lost wood supply in dealing with DWAs, they usually meet the constraints only to the letter, and continue to pursue their economic goals within these constraints.

Consider what happens it if were possible (and I believe it is) to forecast credibly and quantitatively the expected deer population response to a specific set of harvesting and silvicultural plans. Such forecasting will have had to draw up explicit quantitative links between the plans and the deer habitat structure, and thence to deer populations. By altering the plans and generating a set of deer population forecasts for each optional plan, one could begin to explore systematically whether deer actually need winter cover the way conventional wisdom would have us believe. Perhaps different proportions of summer and winter habitat are capable of supporting similar deer populations. Without attempting to forecast deer populations quantitatively, we will never be able to determine whether the Crown's assumptions about the provision of DWAs are sensible.

Back at the decision table, with quantitative deer population forecasts, it is now possible to compare deer supply as well as costs and wood revenues for a variety of harvesting scenarios. If it costs more to get more deer, at least we can now see "best" estimates of how much more it costs to get how many more deer. Indeed, it is conceivable that certain harvesting scenarios could cost the same, yield equivalent wood supply, and provide habitat for a higher deer population. Such opportunities are impossible to identify when constraints founded upon conventional qualitative wisdom are applied to harvesting plans.

In conclusion, companies are likely to pursue an objective of maintained or increased deer populations in forest management planning when population forecasts are quantitative - after all, deer are attractive to woodsworkers, non-woodsworkers, and company shareholders alike! The ear of a decision-maker is likely to be much more receptive to quantified forecasts of environmental performance indicators based on explicit relationships, than to qualitative forecasts and constraints based on gut feeling.

Possibilities for Learning

> Adaptive management is management with a built-in learning process. The design of management goals, the design of the actions, and the measurement of progress are carried out in a manner that allows the manager to learn about the system from his management of it. As the manager learns about the system, he is able to redesign (i.e., adapt) his management approach to be more efficient. Because the adaptive process forces the recognition of error, and therefore facilitates learning, it is a particularly good approach to use in initiating management in systems for which the dynamic structure is not well known, and where it is important to avoid irreversible error.
>
> (Baskerville, 1985)

Learning in EIA, and in resource management, becomes possible when we can tell if our expectations of the future condition of a system of interest, and the actual conditions as the future turns into the present, do not match. If they do match, we were likely lucky in our expectations rather than skillful. When they do not match, it is usually because we were unskillful, not unlucky. A mismatch between expected outcome and actual outcome forces us to reconsider our "models" of the system, to examine critical assumptions and relationships, and to rebuild them into more plausible form and structure.

Error recognition in science and management, i.e., noticing if an expected outcome and the actual outcome are divergent, is extremely difficult if not impossible without (a) a quantitative forecast, (b) a measurement of outcome, and (c) a rigorous comparison of the two. Qualitative forecasts, based on gut feeling, that simply say "little or no impact", or "worse for deer", cannot be tested in any scientific sense, and cannot be used to check whether progress towards management objectives is being made, nor to help determine appropriate actions to rectify undesirable outcomes.

Let us return to the deer and forest harvest plans on crown land in New Brunswick. It is possible to measure whether the forest companies are complying with the terms and conditions of the Crown Lands and Forests Act and the Forest Management Manual, Department of Natural Resources (1984). It is also possible to sample for and estimate deer populations (albeit with rather wide confidence limits) before and during harvesting operations in a specific crown forest. But it would be risky indeed to infer that changes in the deer population, if detected, were attributable to harvest operations, without having constructed explicit quantitative relationships showing (a) how harvest operations are linked to deer populations, and (b) how other influences on deer dynamics (e.g., predation, and hunting) might have affected the deer population over the same time period. In order to learn about the influence of harvesting on deer, one would need to: (a) have generated quantitative forecasts of deer population response to harvest operations, based upon explicit relationships of deer population dynamics; (b) measure, over time, the deer population, as well as the variables which are represented in critical "model" relationships; and (c) be lucky enough to have considerable error in the forecast of the deer population response over time.

To recapitulate, decision-makers and impact analysts are able to learn about how human interventions affect natural systems when forecasts are quantitative and based on explicit system relationships, and when outcomes are measured. The ability of analysts to forecast impacts can thus improve, and decision-makers have a chance to make better decisions.

What to Quantify in Impact Forecasts

Before examining quantitative impact forecasts in more detail, let us look at what a forecast is, and what an impact is. A prediction is defined as a statement specifying the present or future condition of a particular aspect of a system without measuring it, given certain characteristics of the system. A forecast is a special kind of prediction where we specify the future condition of a particular aspect of a system. An impact, if it hasn't happened yet, is the difference between a specific forecast outcome with a specific intervention or action in the system of interest, and the forecast outcome without. If it has already happened or is happening, an impact is the difference between a specific measured outcome with the specific intervention in the system, and the expected or predicted outcome without. Note that in both cases one does not forecast impact directly - it is always a difference, in one case between two forecasts, in the other between a prediction and a measurement. What follows is a brief description of the elements of an impact forecast that need to be quantitatively specified.

Magnitude of Change

Forecasts for environmental performance indicators are most usefully stated in terms of measurable variables, preferably on a ratio scale or interval scale if necessary (see Elliott, 1981). The variable chosen for each indicator needs to be both meaningful to the users (i.e., the decision-makers and certainly the public in EIA), and measurable in the field by the impact analyst. If not the former, the indicator is likely to be seriously considered in decision-making, and if not the latter, learning will be prevented.

Some form of quantitative (read mathematical) modelling will undoubtedly form the basis of quantitative forecasting. For biological/physical impacts, dynamic simulation modelling using state-dependent rules for change and feedback loops (e.g., Walters et al, 1974) is very appropriate. It forces explicit statement of cause-effect linkages which are used to represent the real system of interest.

Probability of Events

If the impact under consideration involves an event that is troublesome to model in a strict cause-effect sense, then the probabilities of occurrence of the event should be quantitatively specified. EIA can learn much here from the risk analysis and engineering fields where it is routine to specify probabilities of event occurrence.

Time and Space Limited

The time horizon of a forecast and the time steps used to reach that horizon need explicit definition, as to the spatial extent of area or volume to which the forecast applies, and the limits of spatial resolution. Time and space beyond the horizons as defined are explicitly left out of the search for impact, and variation on a scale smaller than the units of resolution is ignored.

Conclusion

It maturity in a scientific discipline can be gauged by predictive capability, then ecology is a young science, perhaps even an immature science. Dealing in a predictive way with phenomena that (a) cannot be seen, (b) have great natural variability, (c) grow, and/or (d) exercise behavioural choice, can be overwhelming. However, our arsenal of predictive tools, especially forecasting tools, is larger and more powerful than the reading of a few run-of-the-mill ecology texts and environmental impact statements would lead us to believe. What is required is careful and insightful combination of proposed and tested ecological relationships into dynamic system models designed expressly for exploring specific questions and making specific forecasts about the expected response of particular environmental indicators to particular proposed actions. Only then can scientific follow-up studies in EIA, aimed at testing forecasts, revising thinking, rebuilding models, and re-advising decision-makers, be fruitful.

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ENVIRONMENTAL EFFECTS MONITORING AND ENVIRONMENT CANADA: A SYNTHESIS OF THE FINDINGS OF FOUR WORKSHOPS

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Introduction

Environmental impact assessment (EIA) as practiced in Canada and elsewhere is seen by assessors, proponents and regulators as an incomplete process, and therefore inadequate. Impact assessment has not matured as a learning process because an essential feedback mechanism is missing (Beanlands and Duinker, 1983; National Research Council, 1977). A reasonable information base determined through scientifically valid investigations on the effects of projects on their environments often does not exist. Present practice has not been altered on the basis of past experience because past performance was not measured or evaluated (AIM Ecological Consultants Ltd. 1985). Beanlands and Duinker (1983) concluded with four recommendations, of which the third was to have effects monitoring formally recognized as an integral component of the assessment process.

It was in this context that the Environmental Impact Systems Division (EISD), Environmental Protection Service, Environment Canada, wished to evaluate the concept and potential use of environmental effects monitoring (EEM) as it related to the role and responsibilities of Environment Canada. To this end, EISD sponsored a series of four workshops on Environmental Effects Monitoring in the period from January, 1984, through May, 1985. The first three workshops, held in Halifax, Vancouver and Toronto, involved participants from governments, industry and consulting, and focussed more on technical than Environment Canada management issues. The final workshop, held in Ottawa, involved Environment Canada managers from Ottawa and the regions and concentrated on departmental management and administrative issues. This report represents a synthesis of the findings of the four workshops. All four workshops were carried out using the common set of objectives provided by EISD:

To develop draft Environmental Effect Monitoring (EEM) guidelines and policies for Environment Canada that:

(1) are relevant to operational, middle and senior managers within Environment Canada;

(2) provide technical direction for the design of EEM programs within Environment Canada;

(3) provide management direction on the establishment and management of EEM programs within Environment Canada; and

(4) improve Environment Canada's role as an advocate and advisor in EEM when reviewing EISs, intervening at Panel hearings, advising other government departments on the design and management of EEM programs, establishing baseline information needs, etc.

Definitions

The Oxford Dictionary definition of the verb "monitor", "to keep watch over, to record or test or control the workings of", carries two shades of meaning that apply to Environment Canada's role in environmental monitoring: (1) serving to remind or give warning; and (2) serving to record, observe, or test the operation of something. Environmental Monitoring can be defined as:

> Repetitive data gathering to observe, record, or test the operation of an environmental factor for the purposes of complying, warning, determining the status of, or of evaluating predictions, performance, or evidence of change.

The environmental factors monitored may be either natural or anthropogenic. Many types of environmental monitoring have been identified, largely depending on the objectives of the monitoring program and the relationship of the program executors to the factor being monitored. Inspection, surveillance, and compliance monitoring of a given project or factor all fall within the "complying with expected performance" definition of monitoring. Environmental audits represent the systematic and comprehensive examination of project performance in satisfying environmental goals and objectives, and are often carried out on completion of some project milestone. Status and trends monitoring is carried out to assess and document the status and long-term changes in environmental variables for the purpose of tracking environmental quality.

> Environmental effects monitoring, the subject of this investigation, measures changes in environmental factors to establish cause-effect relationships between a natural or human-generated environmental factor and affected environmental components.

The objectives of environmental effects monitoring may be:

i) to determine consequences,

ii) to test impact predictions and hypotheses,

iii) to test performance and/or mitigative measures,

iv) to improve design and performance of future similar projects,

v) to provide a factual basis for allocation of damage and compensation, and

vi) to help ensure the wise stewardship and well-being of the environment.

The above definitions represent current Canadian perceptions and practices. Before leaving the basic definition of terms, however, it is worth noting the slightly different approach taken by the U.S. National Research Council (1977) in its review of environmental monitoring for the U.S. Environmental Protection Agency. There, environmental monitoring was defined as repeated observations for the study of man's activities as they affect natural phenomena, and how the resulting changes affect man. Three categories of monitoring were described, each designed to answer different questions:

<u>Source Monitoring</u> What residuals enter or will enter the environment? From what sources and in what amounts?

<u>Ambient Monitoring</u> What concentrations of residuals are present in air, water, soil, food, and animal (or plant) tissues?

<u>Effects Monitoring</u> What are the consequences of these residuals for humans, animals, plants, and materials?

No matter what the approach, it is evident that the several types of monitoring are interrelated and tend to grade into each other. The results of one type of program may be used in the design or assessment of the results of another. The results of all types of monitoring programs should be <u>used</u> to assess and, where possible, to improve the performance of the factor or project being monitored and in the interests of improved environmental management and protection.

All monitoring programs have a set of initial measurements. The true <u>environmental baseline</u> is required only when the objective involves the comparison of an original condition at a specific site with a post-disturbance condition for the purposes of effects monitoring. A strong argument can and has been made that nearby conditions outside the zone of influence of a given disturbance source constitute as good or better an experimental control for assessing environmental effects as site-specific pre-disturbance baseline measurements, since both the experimental and control sites are simultaneously subjected to the same natural environmental variables.

Environmental baselines are not required for inspection, compliance, or surveillance monitoring, status and trends monitoring, and environmental audits unless the objective of these types of monitoring is to ensure no deviation in the post-disturbance environmental quality being measured from the pre-disturbance condition, or to ensure that it lies within a given range of change. In these cases, the environmental baseline simply sets the performance standard to be achieved in the post-disturbance condition.

The understanding, assessment, and management of "cumulative" impacts (which includes additive, repetitive, and chronic, or "aggregated" impacts) is a major unresolved environmental issue where more information is required. EEM is an important tool in defining the extent and severity of cumulative effects, and offers managers one mechanism to help decide that individual inputs/changes need more rigorous control due to their additive effects. However, the EEM data base for describing the effects of individual inputs/changes in isolation usually is not yet large enough to satisfy interpretive and management requirements. In these circumstances, it is even more difficult to apply the available results of EEM programs to the demanding requirements of aggregated impact analysis.

Rationale and Functions of Environmental Effects Monitoring Programs

Rationale for Environmental Effects Monitoring Programs

The workshops defined the rationale for conducting environmental effects monitoring programs on specific projects as follows:

> Information derived from well-designed environmental effects monitoring programs carried out during the construction, operation, and/or abandonment phases of development(s) improves capabilities in environmental assessment, impact prediction, impact mitigation, and definition of engineering and performance requirements through provision of essential feedback information.

Results of individual EEM programs may improve environmental decision-making and management for that particular project, but they may also contribute to the management of similar aspects of other current and future projects.

Collectively, EEM programs will generally improve environmental science, management, protection, conservation, and associated decision-making. A resulting benefit may well be the reduction of future environmental management costs.

Functions and Benefits of Environmental Effects Monitoring Programs

EEM programs are designed to establish cause-effect environmental impact relationships, and during execution to detect and quantify impact-related changes in the environment. Actual and predicted impacts can be compared, project performance can be evaluated, and the effectiveness and necessity for mitigative measures can be tested in both the short and long term. Improved technology or other environmental protection strategies may result. Results of EEM programs can contribute to cost/benefit analysis of a variety of project features, processes, and mitigation measures. As a result of all these factors, environmental decision-making capabilities are substantially improved.

Results of EEM programs are a prime information source for environmental planners and managers, and review panel members, and are very useful in Adaptive Environmental Assessment and Management procedures (Holling 1978). Capabilities for anticipating or predicting environmental change are improved. Enhanced environmental assessment capabilities result in better environmental planning, management and protection. The effectiveness of various environmental protection measures can be evaluated. Analysis of results of EEM programs improve the ability to develop meaningful environmental assessment guidelines and environmental regulations.

EEM programs can help to fulfill the proponent's social responsibility to minimize project impacts. The environmental safety of a given operation or procedure can be established. Believable information is provided to regulators, the public, and the courts. EEM results can be used by a project proponent in legal cases as protection against unfounded accusations; this may be especially useful where the public or a public interest group perceives a major environmental impact that the proponent has reason to believe is not there. In cases where EEM program results do demonstrate environmental damage eligible for compensation, they can provide the basis for award of compensation. In the end, once an adequate body of EEM information has been systematically accumulated, reduced costs in environmental planning, assessment, engineering, and technology and enhanced environmental management protection should result. Environmental assessment is currently long and involved, in part because not enough information of the type provided by EEM programs is available to reduce uncertainty about environmental effects to an acceptable level.

Attributes of Environmental Effects Monitoring Programs

The three technical workshops identified a number of attributes of well-designed environmental effects monitoring programs. Published literature in this area reflects the same interests. Most attributes are generally applicable to any well designed scientific investigation; these are vitally important and are included below. However, this discussion is initiated with consideration of attributes unique to EEM programs.

Attributes Unique to Environmental Effects Monitoring Programs

An environmental effects monitoring program is based on clearly defined hypothesis testing related to a specific environmental issue(s) designed to evaluate cause-effect relationships and related ecological significance. The results may be used in assessing performance and consequences, impact prediction, impact validation, impact mitigation, and improved environmental management and protection.

Effects of air pollution, water pollution, and various types of land use historically have been the subjects of EEM programs. These programs may be carried out by federal, provincial, and municipal agencies, or by the industry or industries responsible for the environmental disturbance or release of the pollutant(s) in question. Some investigations are undertaken by universities, specialized research institutes, and consultants funded by a variety of sources, although EEM programs have tended to suffer from the "applied research" stigma (not "pure science", so not worthy of funding) practiced by certain classes of funding agencies. One large group of EEM programs involves effects on human health; these investigations are often conducted by agencies other than national or provincial Departments of Environment.

EEM Program Attributes Common To All Valid Scientific Investigations

A number of attributes of well-designed EEM programs identified by the workshop participants are common to other valid scientific investigations. They are so important, however, that it is worth summarizing them since all too frequently past EEM and other monitoring programs have been conducted under inadequate design or execution protocols, with resulting wastage of time, funds, and resources, and lost opportunity for obtaining vital information.

Program Design

The difference between a good, informative program and program failure often lies in project design. Indeed, in listing attributes it is difficult to make a clear distinction between those that are allocated to project design and to project execution. Any well-planned investigation makes a full and insightful analysis of relevant published literature and, if useful, establishes personal contact with outstanding current investigators in the field. This assists with design and avoids duplication of effort.

A well designed investigation determines the critical issue(s) and factors early in the planning stage, and focuses on (it) them. An interdisciplinary approach may be required in EEM programs since it is frequently necessary to evaluate ecosystem linkages. The collaboration of earth and other physical scientists (physical environmental characteristics and movement of pollutants, etc. through atmosphere, water, or soils and sediments), chemists (physical and chemical characteristics of chemical species, concentrations in various environmental components), biologists (affected and non-affected species abundance, distribution, life history characteristics, behaviour, etc.) and/or medical researchers (environmental health, epidemiology, etc.) may be necessary in a reasonably comprehensive investigation. Realistically, it is often not possible to evaluate more than two ecosystem components with one link between since the secondary linkages can involve many other components and feedback loops. It is far better to restrict the range of an investigation, and do it well, than to investigate a multiplicity of factors in a complex program and do none of them adequately. A good EEM program deals with what needs to be measured, not with what could be measured.

Careful selection of informative variables and receptor targets is critical. For any one issue, a variety of evaluation systems probably exists. For instance, there are many ways to assess the effects of acid rain, or of agricultural runoff. Good definition of the hypothesis to be tested effectively stipulates the data requirements. Hard thinking is necessary to narrowly define the most informative approach to obtain results of maximum relevance to the needs of the particular investigator, agency, industry, or other interested party. One workshop made a special point of identifying the challenge of designing innovative, low cost, maximum information yield effects monitoring programs for use under conditions of fiscal constraint.

The impacts of maximum concern usually involve either man or other living organisms. The selection of target organisms for investigation includes considerations such as a fixed rather than a mobile or migratory way of life, specificity and proportionality of response, a balance between sensitivity and robustness, potential for contaminant bioaccumulation or other informative impact effect, vulnerability (i.e., high potential for contact with the causative factor(s)), a balance between generation replacement rate and longevity of individuals, sufficient abundance to sustain repeated sampling, ease and cost of valid sampling and analysis, and relevance to human interests (commercial species, species included in the human food chain, species with "aesthetic" importance including rare or endangered species, etc.). The latter consideration results in a preference for making measurements on "valued ecosystem components" (Beanlands and Duinker, 1983), provided the results are suitably informative. Workshop participants recognized, however, that the valued ecosystem components of greatest interest may pose difficulties in program design, such as migratory birds spending part of their annual cycle away from the site of interest, or relating particular behaviour patterns or reproductive success in otherwise-stressed large mammals to habitat alteration caused by a particular development.

Appropriate analytical methods and evaluation criteria must be selected for each component measured. Seasonal changes and annual variability must be accounted for as necessary. Time lags in expression of effects must be recognized and planned for. Environmental assimilative and regenerative capacities must also be taken into account; indeed, evaluation of these factors may be one of the objectives of the particular investigation. The program must be designed to separate true effects from spurious correlations, preferably on more than statistical grounds. For instance, an effect that bears a direct quantitative relationship to its causative agent is a much more satisfactory factor to measure in an effects monitoring program than trying to "prove" a cause-effect relationship by statistical correlation against a background of high random population variation influenced by other natural environmental variables that may cause the same type of response.

Unless circumstances dictate otherwise, the EEM project should be planned to yield <u>quantitative</u> results that are scientifically rigorous, statistically sound, meaningful, and significantly improve impact assessment and/or management capabilities. These requirements cannot be taken lightly. Meeting them may demand sophisticated application of principles of experimental design and statistics, a high level of quality assurance/quality control in the associated analyses, rigorous data management and validation procedures, and acceptance of the accompanying increases in costs that these may entail. All too often designated budgets are grossly inadequate to cover such costs even though the particular issue has a very high profile. The resulting data are of questionable or even negative value. These problems were clearly identified in the National Research Council Analytical Studies for the U.S. Environmental Protection Agency a decade ago (National Research Council 1977); unfortunately; the situation probably has not changed significantly. Goldberg and Taylor (1985) present a current argument in favor of data validation; this is but one example of pleas for valid studies that appears periodically as editorials in the scientific literature.

Program Execution

Effective execution of EEM programs flows from good design. Valid and appropriate sampling techniques are used, including validation of techniques, establishment of required numbers of samples, adequate replication, etc. in the preliminary investigations and during the main program. The study area must encompass the zone of influence of the causative agent. Sampling locations must be selected using scientifically valid principles. Control sites must be established, including ones to allow identification of non-impact related co-occurring environmental changes. Sampling plans should recognize appropriate space and time scales. The possible influence of long term cycles and trends should be considered. Definition of good experimental and control baselines during project initiation must be accomplished.

Good EEM program design and planning will have built in the use of proper analytical techniques and adequate quality assurance/quality control procedures. Consistent methodology should be used throughout a given EEM program. However, it may be advantageous or necessary to maintain flexibility so that improvements can be incorporated and unproductive avenues of investigation can be dropped.

Given inevitably limited resources, EEM program efficiency must be maximized. The program must be economical, minimizing waste of means and effort. It should be executed to an appropriate level of detail, avoiding costly overkill. The program should be kept to a manageable size, which relates back to program design. The progam should be bounded spatially, temporally, and fiscally. Sampling logistics should be well planned and cost effective. Programs usually benefit in quality, relevance, and cost control from involvement of designers and executors who are familiar with the area, the system being monitored, and the techniques and facilities being used (but it must be recognized that the only way to get experience is to "do it"). Cost-benefit analysis of a variety of EEM programs would be beneficial to establish which approaches are most productive, and where the returns on funds and efforts are poor.

Program Reporting

Finally, it is vitally important that the results of EEM programs be reported to other investigators, government and industry planners and managers, other interested parties, and, as appropriate, the interested public. Reporting for internal use only may result in duplication of effort, or imposition of unnecessary and potentially costly performance standards if the appropriate agencies have not been informed about pertinent feedback information. More publication in the primary scientific literature is urged to enhance wide distribution to the scientific and technical community, but publication in the government, industrial or consulting "grey literature" is far better than no publication at all. Reporting negative results is just as important as reporting positive results, providing the investigation was scientifically valid. This is the most effective way to enhance the learning process and provide the feedback mechanism essential to good science and improved environmental assessment.

Further EEM Program Considerations

Experience with the design and execution of EEM programs to date has identified a number of considerations that may help in developing policies and frameworks for EEM in Environment Canada and elsewhere. They are considered briefly in the following paragraphs.

Defining three types of impact "zones of influence" helps in designing EEM programs. They are the Zone of Physical Disturbance, the Zone of Influence of Routine Events, and the Zone of Influence of Major Accidental Events. The first may be contained within the second, and the first and second may be contained within the third. The complications imposed by migratory or passively dispersed (by wind or water currents) affected populations must be taken into account. This approach helps to define boundaries in both space and time. The concept is discussed in Conover et al (1985 a,b).

Predictive modelling is a very useful tool in impact analysis, and is an excellent way to formulate the hypothesis that is tested by a follow-through EEM program. Dispersion (or "fate" or fugacity) modelling is one of the most useful and realistic types of modelling available in impact analysis. Figure 1 (redrawn from Friar and Coupal (1985)) is a good illustration of the results of a predictive model subsequently tested with an appropriate EEM program. This program accounted for deposition of residues on vegetation and soils, but did not include transport in riverine systems. Samuels and Lanfear (1982) used predictive oil spill behaviour and fate modelling coupled with bird population modelling to predict the impacts of an oil spill on sensitive and vulnerable seabird populations. Here the only possible EEM validation program would be investigations during an accidental oil spill.

Scientific rigour, statistical soundness, and quality assurance/quality control may impose significant sampling and analytical costs when the environment being sampled is very variable and/or the analytical error is relatively large. If the costs of individual analyses are high, such as with organic chemical analysis using gas chromatography or gas chromatography/mass spectrometry techniques, the costs of "good science" may become formidable. The cost implications in the NOAA Ocean Assessments Division Status and Trends Program (NOAA, 1984) are a good illustration of this problem. The full program dictated by good statistical design could not be met with the resources available, so a compromise program was recommended instead. Such compromises must be carefully evaluated to determine whether they will yield sufficient valid data. There is little point in wasting resources on the collection of data that cannot be validated (Goldberg and Taylor, 1985).

Most of the environmental impacts of concern involve effects on living organisms, populations or communities. Sometimes the choice of the target organism and the method of measuring the effect are very obvious in designing EEM programs, but more often the investigator is faced with a bewildering range of potential target systems, organisms, and levels of biological organization (which may all be related to "valued ecosystem components"), and choice of analytical techniques. Figure 2 is based on a schematic diagram developed to help organize our thinking when selecting biological components for use in a monitoring program (Hardy Associates, 1985). Analyses of individual organisms require the least

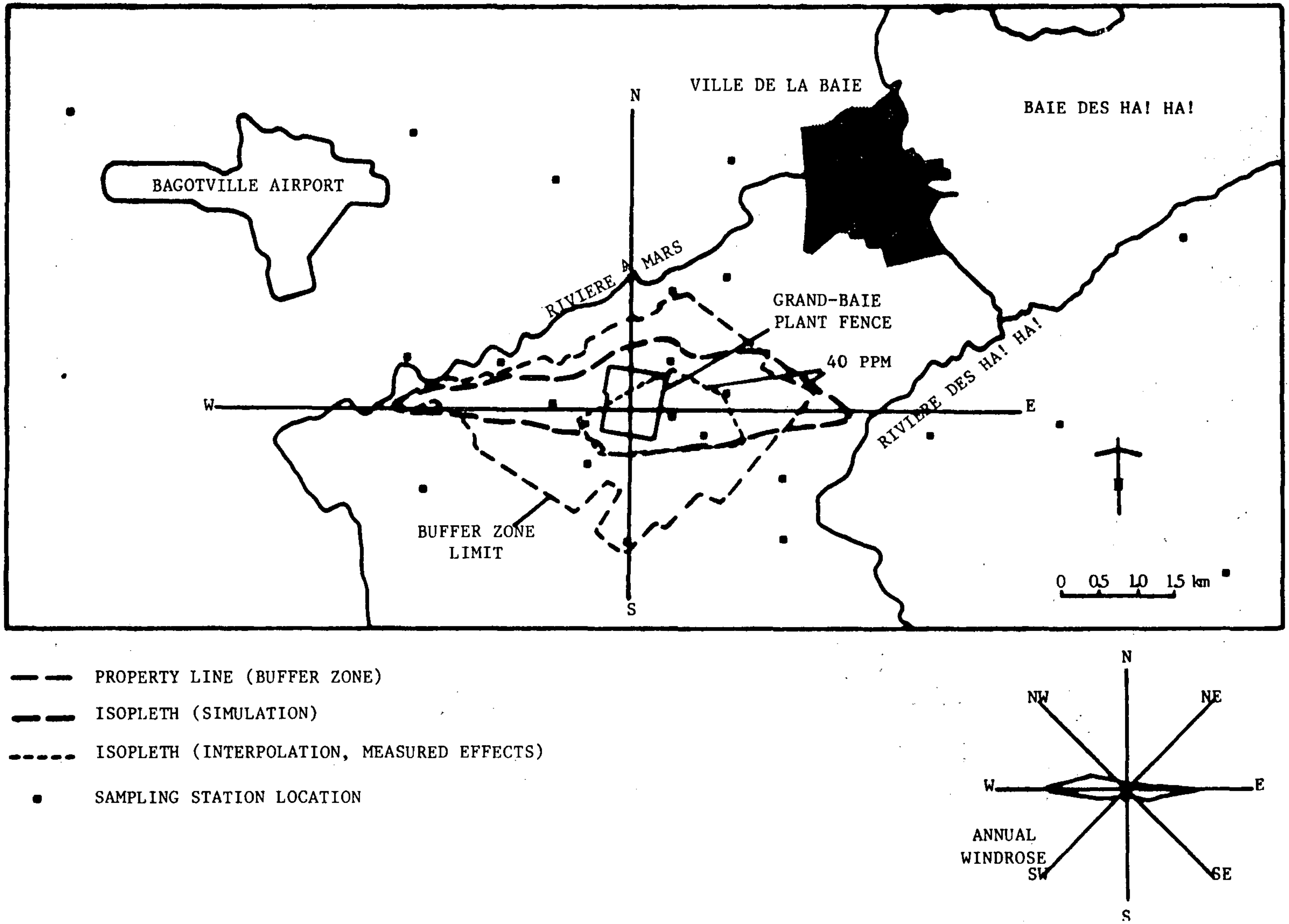

FIGURE 1 DISPERSION ANALYSIS OF FLUORIDE. PREDICTION OF EFFECTS OF FLUORIDE EMISSIONS AND RESULTANT BUFFER ZONE FOR ALUMINUM REDUCTION PLANT; AND MEASURED EFFECTS OF FLUORIDE EMISSIONS BASED ON 1984 FORAGE DATA (FULL PLANT OPERATION).

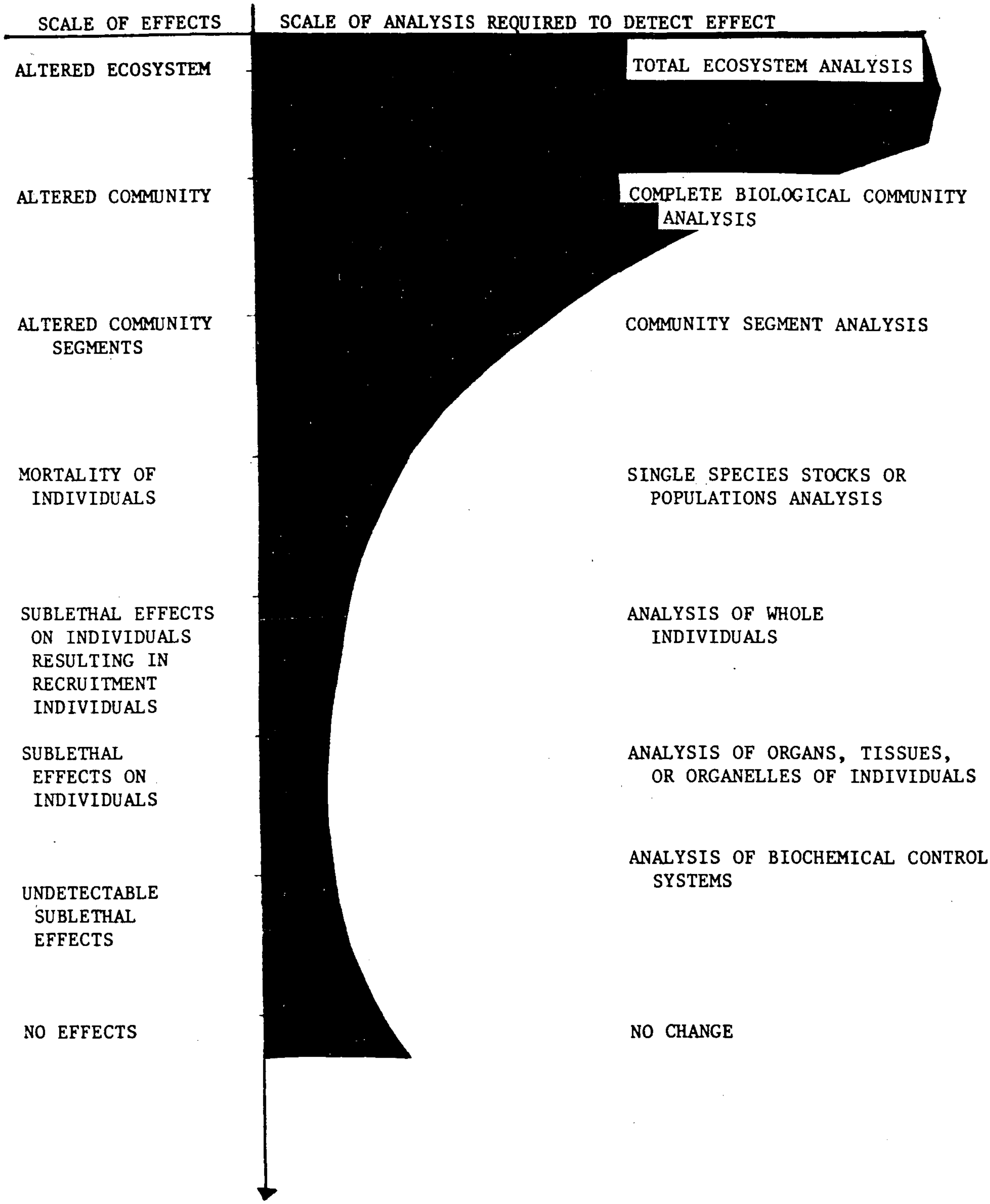

FIGURE 2 SCHEMATIC DIAGRAM OF THE RELATIONSHIPS BETWEEN LEVELS OF IMPACT EFFECTS AND THE ANALYSIS REQUIRED TO DETECT THEM

analytical effort to detect effects provided they are informative, unambiguous, cost effective, and can be interpreted in terms of effects at the population and community levels. McIntyre et al (1978) is a good basic reference in this area, and Bayne (1985) introduces an interesting series of pertinent investigations.

One problem that can emerge during the design of EEM programs is the non-specific nature of biological responses to a wide variety of causal factors. For example:

1) Organisms die for a lot of reasons, but the effect on the organism and the population is the same.
2) A large number of compounds have carcinogenic effects that appear to be expressed in the same or very similar ways.
3) The immediate causal effect may be only the indirect result of the stressing effect; the terminally ill cancer patient dying of pneumonia is such a case.

There are two ways of dealing with this. First, one seeks a system where the cause-effect relationship is direct, specific, unambiguous, measurable, and, if possible, quantitatively proportional. Failing that, one may have to measure a complex of variables that appear to be correlated - a syndrome - such as environmental dose-exposure data, body burden, and the occurrence of a sublethal effect that has been related to the other two in laboratory investigations.

Finally, the EEM programs considered by the workshops measure biophysical effects. The same basic approach should be applicable to socioeconomic effects monitoring, with the same resulting benefits. Socioeconomic impact assessment may not yet have evolved to the level that well defined EEM programs are possible or appropriate (Carley, 1984; Carley and Bustelo, 1984). However, some progress is being made (Leistritz and Chase, 1982; Shopley and Fuggle, 1984). Just as future environmental assessments demand a much better integration of biophysical and socioeconomic impact analysis in the service of improved environmental management, EEM programs with their hypothesis testing and impact prediction validation will be necessary in both areas.

Other Aspects of Environmental Effects Monitoring Programs

When To Do Environmental Effects Monitoring Programs

Since valid EEM programs are demanding, workshop participants considered under what circumstances EEM programs should be recommended or required for specific projects or generic issues. The decision to undertake EEM programs is influenced by the related concepts of risk and probability. When it is virtually certain that an impact will, or will not, occur, there is no need to carry out an EEM program (unless it is important to quantify the expected impact). When there is a significant degree of uncertainty about whether an impact will occur, its mode of expression, or its extent, an EEM program should be considered. As results of completed EEM programs become more available, the existing data base may become sufficient for the users' needs, i.e., the certainty of existing knowledge becomes sufficient. Thus the first criterion for recommending or executing an EEM program is that an unacceptable degree of uncertainty exists.

The second criterion in determining whether or not to carry out EEM programs is that the issue is sufficiently significant to require the necessary expenditure of effort and resources. "Significance" may be defined by the industry itself, impact assessors, environmental review panels, responsible governmental managers, public interest groups, the general public, or some combination of these.

The third criterion for determining whether to undertake an EEM program is that the benefits in essential information returns for environmental protection outweigh the costs of executing the program. The costs may be financial, development delays, or foregone opportunity for development. Benefits may be environmental, economic, social, political, scientific, or for legal protection of the proponent or other affected party. Cost/benefit analysis may be useful in making the decision whether to carry out an EEM program as long as it is recognized that some of the benefits may be difficult to quantify in strictly monetary terms.

Who Pays For Environmental Effects Monitoring Programs

The workshop consensus was clear on responsibilities for bearing the costs of EEM programs. In Canadian practice, if information is <u>essential</u> for decision-making relative to the environmental acceptability of a given proposal, the proposal proponent is responsible for seeing that an acceptable EEM program is carried out, and paying for it. If, on the other hand, the information is <u>desirable</u> for improving the environmental management knowledge base but is not essential for decision-making for any specific project, then government (at the appropriate levels) should bear the cost. There is room for negotiation on provision of contributions in kind by proponents, use of government facilities (on a cost-recovery basis) for high cost or low demand analyses, contributions by other interested parties, etc. Where distant boundaries in space or time are involved, some negotiation between the proponent and the government may be necessary to determine whether there is a responsibility for government financial support.

No operation should be allowed to create a permanent hazard or leave behind an environmental threat that other agencies may have to deal with in the future on behalf of public or environmental safety. If good operational standards are met, no permanent hazard should exist. On project termination, the proponent is expected to achieve a stable end condition as it is the current practice in regulating the mining industry. Government confirms that regulatory standards in this regard have been met before permitting the proponent to "sign off" the project. After that, government assumes the responsibility for ongoing check testing to confirm that the standards set have ensured the necessary environmental protection.

Dealing with cost allocation in problem "cumulative" impact situations is complex; old and new industrial proponents may be involved, as well as several levels of government (as builders and operators of highways, sewage treatment plants, waste disposal sites, etc.). Workshop participants perceived that (normally) the most senior level of government involved should act as the organizer of a cooperative effort in such circumstances, and may also have to provide at least some of the funds. Negotiations to carry out essential EEM programs on "cumulative" effects may involve industries or industry associations, other privately operated causative installations (such as hazardous waste management companies), and several levels of government to ensure fair cost-sharing. These negotiations may take place under regulatory requirements or under environmental assessment requirements already in place.

An EEM program should be designed to answer this particular question. It should be based on the "zone of influence" (in space and time) concept, and should not be constrained by the limits of the proponent's property ownership. (This concept was hotly contested in one workshop, where industry representatives took the position that they were responsible for monitoring only within their property boundaries.)

When EEM programs are deemed essential in coming to grips with a large generic issue (such as safe disposal of acid mine wastes or refinery effluents), one strategy for controlling costs and limiting expectations of individual proponents to reasonable levels is to narrowly define a series of related EEM programs, and have each program executed at different proposal sites and/or over time. In this way, no one proponent must bear and unfair cost burden, and the whole industry benefits. Clearly, an effective planning and long term overseeing role for government and/or an industry association is implicit in sustaining such a strategy.

Environment Canada and Environmental Effects Monitoring

The first three workshops made up of a mixture of participants identified a number of policy and management issues that pertained to Environment Canada, but the final workshop, made up exclusively of Environment Canada managers, provided the definitive response to the third and fourth objectives defined in the Introduction.

General Considerations

Workshop discussions broadened the role and application of EEM to include many aspects of environmental planning and management, not just environmental impact assessment *per se*. This is consistent with the recognition of the more general role that environmental assessment techniques and approaches play in any scientific or other analytical effort directed toward environmental management.

One important consideration was identified in regard to initiation of EEM programs within Environment Canada or their advocacy in other government agencies: a large amount of information already exists within Environment Canada and elsewhere in the literature that *may* already answer *some* of the knowledge requirements that EEM programs might otherwise be designed to fill. Real benefits could be achieved within Environment Canada by improving on the communication of existing information, and coordinating related programs within the Department. The challenges of becoming aware of EEM-related information are even greater between federal departments. Workshop participants believed that improved *information management* and access is a necessity.

This discussion identified a hierarchy in the use of information. The accumulation of information leads to knowledge, and the accumulation and *assimilation* of knowledge leads to wisdom. Wisdom was seen as an essential ingredient in determining when to recommend undertaking an EEM program (or any other important initiative, for that matter). It was recognized that information collected for one purpose may not be suitable for providing definitive answers for another purpose; this is liable to happen in a large and somewhat fragmented organization such as Environment Canada. The Department was seen as succeeding in "component" management, but being weaker in "system" management, with resulting implications for broad scale undertakings such as EEM program initiatives. Nonetheless, the convictions remained that it would be prudent and economically beneficial if information already retained by the Department was properly evaluated before embarking on EEM program initiatives. At the very minimum, existing information permits scoping, and defines areas where EEM programs are still necessary.

Framework for Environmental Effects Monitoring Programs in Environment Canada

Once the value of EEM programs as a tool in environmental planning and management is accepted, it is necessary to determine whether new policies and management frameworks will have to be put in place in Environment Canada to accommodate EEM programs. It was concluded that the necessary framework to recommend and execute EEM programs within the Department is already in place. Several divisions within Environment Canada already foster EEM programs. A notable example is Parks Canada, where programs are regularly executed to monitor the success and adequacy of courses of action specified in Resource Management Plans. They are also used to evaluate the success of impact mitigation measures applied to park developments, and to identify and correct undesirable trends and problems not addressed in Resource Management Plans or resulting from mitigating the impact of a development (Parks Canada, 1980, 1985).

The opportunity to improve coordination between Environment Canada divisions exists both generally and in the context of EEM programs. It is also possible in some cases to build EEM program requirements into existing and newly negotiated arrangements for environmental management with individual provinces.

The greatest problem comes in convincing other government departments to recognize the benefits of EEM programs and nurture their implementation. Environment Canada plays an advocacy role in this. The Environmental Assessment and Review Process (EARP) provides one advocacy opportunity. Under the EARP Guidelines Order-in-Council, it is the responsibility of the initiating department to ensure,

> in cooperation with other bodies concerned with the proposal, that any decisions made by the appropriate Ministers as a result of the conclusions and recommendations reached by a Panel from the public review of a proposal are incorporated into the design, construction and operation of that proposal and that suitable implementation, inspection and environmental monitoring programs are established.

If there is a clear need for EEM programs, the Minister of Environment's role is to influence the Minister of the initiating department to require the necessary EEM program of the proponent.

In the Government Organization Act of 1979 and in 1984 EARP Guidelines-in-Council, an advisory role in recommending monitoring programs was identified as Environment Canada's mandate (Environment Canada 1980). Environment Canada can influence the responsible agencies to require EEM or other monitoring programs, which usually involves convincing the initiating department of the value of particular EEM programs. The same applies to provincial agencies where federal-provincial joint agreements apply. This is a weak position with little leverage. The workshop participants recommended that a statement be made by Environment Canada that provides supplementary information on monitoring requirements for the 1984 Order-in-Council monitoring requirements section, including identification of the desirability of EEM programs where essential, and referencing Environment Canada's willingness to assist other departments and agencies on request. A legislated mandate might be more desirable, but might also have some disadvantages, such as excessive rigidity, and possible unnecessary costs.

Under the EARP Guidelines, workshop participants recommended an enhanced role for Environment Canada in the project screening process in initiating departments. This would be very beneficial in the identification of critical knowledge gaps that impact on decision-making and in the advocacy of EEM programs that would fill these gaps. Arrangements to do this exist already with some departments, but not with some other important ones. It was held desirable that all departments be required to comply with the Environment Canada statement referenced above. Improvements in accountability of the initiating department during the screening process would also be desirable.

Regulatory requirements can provide the necessary opportunity and leverage to get essential EEM programs done, especially during the construction or operational phases of a project's life cycle. This should include reporting back. The point of doing EEM programs is to increase the information base essential for planning, management, and decision-making during all phases of the project life cycle.

Environment Canada will probably always want to audit the results of EEM programs to serve a variety of departmental needs. It is essential that Environment

Canada sustain its technical capability in order to do this effectively for EEM programs as well as for many other departmental responsibilities.

Identification of the Need for Environmental Effects Monitoring

In the context of Environment Canada's responsibilities, indicators that can be used to determine when EEM programs should be promoted or recommended either internally or to other agencies include:

1) when the pre-development baseline and/or the relevant technical information base are inadequate to predict critical effects of the proposal on the environment with adequate certainty for the department's requirements, especially effects on valued ecosystem components (this includes adequate certainty in predictions of "cumulative" impacts);
2) when a public hearing process reveals an inadequate information base for decision-making in regard to a certain issue(s);
3) when the public perceives that a review process or a regulatory procedure is inadequate in regard to a particular issue;
4) when it is necessary or desirable to test or improve the accuracy of particular impact predictions;
5) when a mitigation measure(s) needs to be tested and/or adjusted; and
6) when there is uncertainty about the efficacy or even necessity for a particular regulatory procedure(s).

These indicators may be identified by the proponents, the initiating department, technical experts either internal or external to Environment Canada, review panels and their technical experts, or the general public.

Influencing Other Departments and Agencies

Environment Canada frequently must influence other government agencies, both federal and provincial, to develop and sustain needed environmental protection and conservation measures. The results of essential follow-up EEM programs pertaining to sensitive environmental issues will provide welcome reenforcement. Environment Canada needs the results of EEM programs to carry out its responsibilities more effectively.

Environment Canada's leadership role is constrained by government institutional arrangements, and varies with its Minister's expectations and actions, and the priorities of the current Government. To date, a leadership role may be taken in high profile issues, especially if any necessary extra funding can be supplied from sources other than the regular departmental operating budget. Farther down the management structure, the leadership role varies from region to region, depending on the capabilities and interests of other (provincial and municipal) government agencies in the region and what responsibility-sharing agreements have been put in place.

Many environmental problems are best resolved by a holistic interdisciplinary approach. Results of EEM programs are a powerful tool in the resolution of such problems. The range of factors involved may dictate cooperative programs with other federal departments or levels of government. There are precedents for integrated interdepartmental programs. Departments and agencies that might be involved, depending on the nature of the particular issue, include Fisheries and Oceans, Forestry, Agriculture, Health and Welfare, Energy Mines and Resources, Public Works, Transport, Indian and Northern Affairs, Canada Oil and Gas Lands Administration, National Energy Board, Atomic Energy Commission, and the Ministry of State for Science and Technology. Historically, some of these have been more receptive than others to cooperative initiatives such as EEM programs. The ultimate interdepartmental mechanism is at the Minister to Minister level.

A number of interdepartmental committees for environmental matters of mutual interest already exist, such as the Regional Screening Coordinating Committees, the Interdepartmental Committee on Environmental Issues (made up of Directors General), the Interdepartmental Environmental Review Committee, the Interdepartmental Committee on Toxic Chemicals, and the Resource Management Environment Committee. These committees can be effective mechanisms for achieving interdepartmental cooperation on initiatives such as EEM programs, and influencing their acceptance and implementation by other departments. The importance of good environmental coordinators in other agencies was identified; this comes down to the importance of the individual and individual relationships.

There are a variety of regulatory processes through which Environment Canada can influence good environmental practices, including EEM programs where required. They include the NEB process, the EARP process as administered by FEARO, the Canadian Transport Commission's TERMPOL process, the procedures of the Northern Canadian Power Commission, various provincial and territorial government procedures, federal-provincial boards, and bodies such as that administering the James Bay Agreement.

The "cumulative" effects of a variety of small regional projects, supported federally by several departments, were identified as an area of concern. Such projects are screened individually by different departments in isolation so do not "appear" to have important environmental effects, but the aggregate effects can be significant. Examples of such collective developments that could, or already have, benefited from application of information derived from EEM programs include wharf/fish plant/aquaculture complexes, and many small hydro dams on trout streams in Ontario.

The leadership role for Environment Canada is fairly clear in trans-boundary or other international programs. Work with other jurisdictions requires cooperation, and often negotiation, be it for requiring EEM programs, or other ways of handling the environmental issues involved. While administrative matters may be complex, arrangements are often made for respective scientific and technical experts to communicate and work together directly, depending on the nature of the issues and resulting agreements. Promotion of EEM programs could take place through such agencies as ICES, OECD and UNEP if Canadian interests were seen to extend to such collective international organizations. Mechanisms are already in place in Canada to handle certain international emergencies such as oil spills.

Sustaining Long Term Initiatives

Departmental priorities are constantly changing, often affecting any programs that require a long term, sustained effort. A number of EEM programs will fall into this category, since measuring many types of environmental change is a slow process. Long range strategic planning assists in this area, but changes in priorities, personnel, allocation of financial resources and person-years, and requirements for immediate "fire fighting" can all negatively impact long term EEM programs. This problem was identified by the workshops, but obvious solutions were not forthcoming, beyond recognizing the importance of long time-series data sets in environmental effects monitoring.

Information Management and Quality Control

As referenced above, information management and quality assurance/quality control are both important issues in EEM programs as well as elsewhere.

Quality assurance/quality control (QA/QC) is essential in EEM programs. Data compatibility between programs needs to be assured; a national or general statement cannot be made with non-compatible data sets. Suggestions to assist in bringing this about included demonstration by Environment Canada that its own house is in order in regard to data compatibility and QA/QC (for instance, wider distribution of the two QA/QC reports produced by the Toxic Chemicals Division), and review by Environment Canada of EEM program designs developed by other agencies to provide guidance on meeting standards. The Department can also advise EARP panels, initiating departments, other agencies, and proponents involved in an environmental assessment to specify EEM programs with compatible data outputs and to demonstrate adequate QA/QC procedures at the time of submission of results.

QA/QC is a major management problem for any agency including the Canadian government; usually there is no mechanism that results in systematic identification of bad data. There may be problems in getting allocations of adequate funds and technical person-years, especially when an expansion of effort is required.

The importance of good formal and informal information management within Environment Canada and within the Canadian government generally was identified. This pertains in many areas, not just information relevant to EEM programs. Poor information transfer is an impediment to accomplishing the responsibilities of the Department. The relevant information needs to be available to determine whether an EEM program is required. Ready access to the existing information base also allows for building on results of previous investigations, including long term programs that may be especially useful.

A number of suggestions were made to help improve this situation, including publication in the primary literature, monthly information bulletins on what EEM programs are being conducted where and for what purpose, making use of the Environment Canada Information Directorate so interested parties could access what was being done, developing a bibliography of relevant "grey literature", and exchange of information on EEM programs between federal government departments. Where it was deemed important to keep the public informed, periodic news releases on EEM programs relating to important issues could be issued by the Department. Public consultation or information meetings could be scheduled on the basis of regional or issue-specific interest. If joint programs with provincial or industrial groups are involved, arrangements acceptable to all parties would have to be made for release of information. A need for a permanent central repository for EEM reports was also identified.

Overall, it was concluded that a greater effort should be made to publish interpretive reports of results of monitoring programs, especially EEM programs. Such reports need to report clearly why the program was done, what data were collected and why, and what the results mean. Results of all monitoring programs need to be interpreted and utilized in environmental planning and management; this is especially important when long term programs are involved.

Recommendations

The main findings of the four workshops can be summarized as a set of recommendations.

(1) Environmental effects monitoring (EEM) programs should be recognized as a powerful source of information on the effects of given natural or anthropogenic causative factors on other environmental components, and such information should be used for more effective environmental planning, management and decision-making.

(2) EEM programs should be designed recognizing the unique attributes of EEM (hypothesis testing to evaluate specific cause-effect relationships and their related ecological significance), and should encompass the attributes of all valid scientific programs, including adequate quality assurance/quality control procedures.

(3) EEM programs should be carried out when uncertainty exists about the nature or extent of an effect caused by a particular natural or anthropogenic environmental factor(s), the information is essential for environmental planning or management, and the EEM program can be executed in a cost-effective manner.

(4) An EEM program should be designed to answer a particular question (hypothesis), and should be based on the "zone of influence" (in space and time) concept, and should not be constrained by the limits of the proponent's property ownership.

(5) If information essential for decision-making relative to the environmental acceptability of a particular proposal can be provided by an EEM program, the proponent should execute and pay for the program. If information derived from EEM programs is desirable for improving the general knowledge base for environmental planning and management, the appropriate level of government should execute and pay. If a generic issue is to be investigated using EEM

programs, and several proponents, agencies, and/or levels of government are involved, cooperative cost sharing arrangements should be negotiated, with the senior government environmental agency taking the leadership role in organization and negotiation.

(6) Environmental effects monitoring should be formally recognized as an integral component of the environmental assessment process.

(7) In addition to its role in the environmental assessment process, the usefulness of EEM in all aspects of environmental planning and management should be recognized.

(8) No new mechanism to foster EEM programs within Environment Canada is needed, but the many existing mechanisms within the department and with other federal government departments, other levels of government, and other agencies should be actively used to promote EEM programs.

(9) A statement should be made by Environment Canada that provides supplementary information on monitoring requirements for the 1984 Order-in-Council monitoring requirement section, including identification of the desirability of EEM programs where essential, and referencing Environment Canada's willingness to assist other departments and agencies on request.

(10) Certain EEM programs will require long term sustained effort, and governments or others will need to make the necessary commitments to ensure they are brought to fruition.

(11) An increased effort should be made to interpret and publish the results of monitoring programs, especially EEM programs. Efforts should be encouraged to improve information management and access within and between all agencies carrying out environmental monitoring programs to aid program planning and prevent duplication of effort.

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PREDICTING ENVIRONMENTAL IMPACTS OF HYDROELECTRIC DEVELOPMENTS IN CANADA

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Introduction

In recent years, the effectiveness of environmental impact assessment (EIA) studies at predicting the impacts of human activities has come under serious challenge. As Beanlands and Duinker (1983) pointed out, the political and associated administrative aspects of the EIA process had developed a level of sophistication that outstripped the scientific aspects. They argued compellingly for a new, more scientifically sound approach to EIA which would allow studies to more effectively predict and detect impacts.

Beanlands and Duinker outlined a number of important steps which form the basis of a scientifically defensible impact assessment. In particular, they emphasize the need for the identification of a clearly stated set of hypotheses which describe, in scientifically testable terms, the expected impacts of the proposed development. These hypotheses should relate to impacts on "valued ecosystem components" (VECs), and should be sufficiently precise to allow the design of post-development studies to assess their validity. They also emphasize the need to specifically define the boundaries (spatial and temporal) which will determine the context of the study. Finally, they emphasize the need for a commitment to undertake monitoring before and after a development occurs to allow adequate assessment of impacts.

An overriding theme of this study is that the key to any analysis of predicted impacts of development is a clear and unambiguous statement of the prediction itself. Past experience with EIA has shown that often this is not the case. Thus, this study devotes significant effort to a reassessment and evaluation of the predictions found in EIAs from various hydroelectric developments. Without this effort, the creation of a generalized data base or information system to assess the

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validity of impact predictions would be much more difficult and probably less useful.

Another key feature of the approach taken in this study is its focus on the analysis on impacts rather than on projects. Assessments from various hydroelectric projects across Canada were reviewed and a set of generic impact hypotheses that capture much of the specifics described in many of the EISs are being developed. In other words, many of the impacts described in the reviewed EISs, with some modification, are common to several projects. This has allowed for the development of a more general analytical framework than would be possible from an approach based on projects.

Approach

The overall objective of this study is to determine the extent to which environmental predictions made during the environmental assessments of selected hydroelectric projects in Canada have been confirmed by post-development experiences. This paper does not present the complete story since most of the analysis is still currently in progress. Rather, it describes the approach taken in the study and highlights some of the preliminary results.

The scope of the project is clearly limited to consideration of those cases which have a definite pre-development impact prediction, together with relevant data on both pre- and post-development conditions. However, there are few projects with a suitable level (both quantity and kind) of data that lend themselves to a rigorous evaluation of prediction capability.

At the outset, it may be useful to review other studies that are directly relevant to this study and had a direct bearing on the methods applied. Numerous case histories of projects concerned with environmental planning and assessment have been conducted over the past few years. Two important reviews of broad sets of examples are found in Beanlands and Duinker (1983) and ESSA Ltd. (1982). An important study that was directed solely at auditing the predictions made during impact assessment (for oil and gas development) was conducted by the Center for Environmental Management and Planning at the University of Aberdeen (formerly the PADC unit). This study (Tomlinson and Bisset, 1982) established the following research goals:

1) to identify impact predictions and test their accuracy;

2) to identify and test techniques used to predict impacts; and
3) to determine whether methods used in the preparation of environmental impact statements (EISs) identified all impacts known to have occurred.

In the first phase of the study, projects completed in the last ten years were preselected to allow comparisons to be made between predicted impacts and actual impacts once the development was operational. In light of this, the general conclusions are extremely sobering:

> "Although it was possible to identify impact predictions, it was very difficult to find predictions which could be audited. There were three main reasons for this finding:
>
> (i) many predictions depended on impacts occurring under specified conditions. If the impacts occurred under conditions other than specified in the predictions, then they could not be audited. This was the case for a large number of oil spill predictions;
>
> (ii) a lack of monitoring data precluded the auditing of many predictions; and
>
> (iii) some predictions were expressed in a form which made their meaning unclear and auditing impossible."

This experience shows that attempts to evaluate the accuracy of impact predictions are fraught with methodological difficulties. In general, one can expect that follow-up studies that focus on this aspect of environmental assessment are likely to reach similar conclusions to the Aberdeen study. The results of such studies are likely to be that impact assessment methodologies need to define impacts in such a way that makes post-audit traceable. Unfortunately, this may not be enough. A recent study conducted by the National Research Council of Canada on scientific capability to detect development-induced changes in aquatic ecosystems suggests that current sampling procedures and methods of statistical analysis are limited. Except in cases where a catastrophic change occurs, current procedures require a number of years of data before and after the start of the activity before reliable estimates can be made (Yorque, 1984).

Given the above conclusions and the absence of good pre- and post-project data for hydroelectric schemes in Canada, a more generic approach to the study was taken. We specifically selected data relevant to evaluating a set of impact hypotheses. This was developed through an extensive review of most of the EISs available for Canadian hydroelectric facilities which are currently operational. Impact hypotheses are statements of cause and effect describing the major biophysical and social processes (i.e., linkages) that connect a specific development activity to a valued ecosystem component. This approach has proven successful in focussing environmental research and monitoring studies (Beaufort Environmental Monitoring Project, 1984; Greig et al., 1984; Marmorek et al., 1984a, 1984b; Mackenzie Environmental Monitoring Program, 1985).

What Has Been Done?

Initial Review

The first task was to establish a clear statement of the predictions made in the EIS documents selected for review in this study. All the Hydro authorities across Canada were contacted (either by telephone or personal visit) and asked four questions:

1) which projects have been subject to EISs?
2) for these projects, which ones have pre- and/or post-development data on aspects of the biophysical or social system?
3) where is this data and how can it be accessed?
4) whether all the projected impacts of the development documented in the EIS or whether other documents (or individuals) should be incorporated?

Selection of Projects

After initial review of the documents obtained, two criteria were established for including projects in the study.

1) The project had to be completed and operational. EISs have been prepared for proposed hydroelectric developments across the country in the last decade. Most schemes, however, have not been built; therefore no follow-up data for pre/post comparisons are available.
2) There had to be some form of a pre-development impact assessment. Many of the documents obtained were very narrow in focus. Projects were not considered if there was not a reasonable collection of information on one of the focal topics (i.e., aquatic, terrestrial, social).

Based on these criteria, the following projects were selected for detailed review:

Newfoundland

- Cat Arm
- Hinds Lake
- Upper Salmon

Nova Scotia

- Wreck Cove

Quebec

- Eastmain-Opinaca Diversion
- Caniapiscau Diversion
- La Grande Complex
- Centrale Rivière-des-Prairies

Manitoba

- Churchill-Nelson (downstream effects)

Saskatchewan

- Nipiwan

British Columbia

- Seven Mile
- Mica
- Site One
- Revelstoke

EIS documents for each project were established as the master documentation for this phase of the study. Supporting documents were reviewed only as necessary to help clarify information in the EIS. Thus, only impact hypotheses documented in the EISs were included in the analysis. For older projects (e.g., Mica), where no formal EIS exists, predictions were taken from reports collectively summarizing the pre-development studies.

The EIS documents for these projects were reviewed in detail, and impact hypotheses were developed for the aquatic, terrestrial, and socio-economic components of the development. This inventory of impact predictions and supporting data is now being finalized in a 300 page document that will form one of the major products of this study. Some example hypotheses are shown in Figures 1 to 3.

Consolidation of Information

Workshop

Following the review, the hypotheses were distributed to all members of the project team. The Canadian Electrical Association (CEA) appointed technical advisors in preparation for a three day consolidation and planning workshop. The workshop served two purposes:

1) to integrate the large set of impact hypotheses derived from the various projects into a smaller set of common hypotheses organized on an impact basis; and
2) to review the methods to be used in the analysis of the pre- and post-development situation.

Standardization of Impact Hypotheses

The technique of expressing predictions made in EIS documents as structured impact hypotheses offers at least two advantages. First, the mechanism behind the prediction is explicitly stated as part of the hypothesis. Second, the hypotheses are cast into a common framework facilitating comparison among projects, where adequate data exist and analysis is justified.

Notwithstanding the above advantages, two issues were kept in mind when preparing and interpreting the impact predictions.

1) The intent of the wording used in the original EIS statement was preserved as much as possible in the impact hypothesis diagrams and subsequent analysis. In developing generic hypotheses, some grouping is necessary; in analyzing a particular prediction, the original wording should be used.
2) The definition of a valued ecosystem component (VEC) has evolved over the 20 year period of assessment work this project spans, so care was exercised not to misinterpret the original EIS prediction based on current thinking and knowledge.

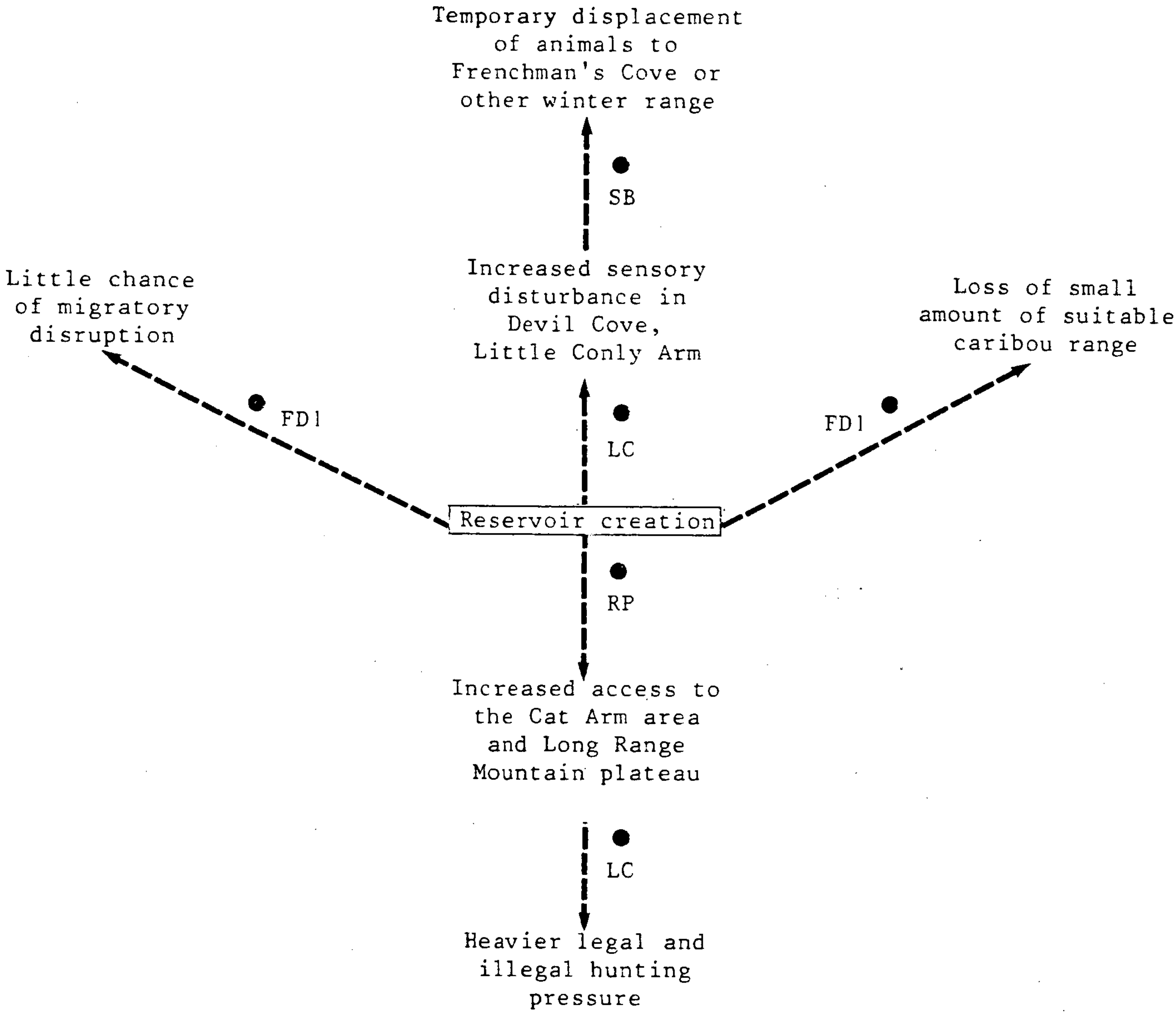


FIGURE 1 WILDLIFE - CARIBOU: EXAMPLE OF A TERRESTRIAL IMPACT HYPOTHESIS TAKEN FROM THE EIS FOR THE CAT ARM PROJECT (Newfoundland and Labrador Hydro, 1980)

Note: Categories on the arrows are explained in Table 1. The item enclosed in a box is the initiating project activity that generates the predicted impact.

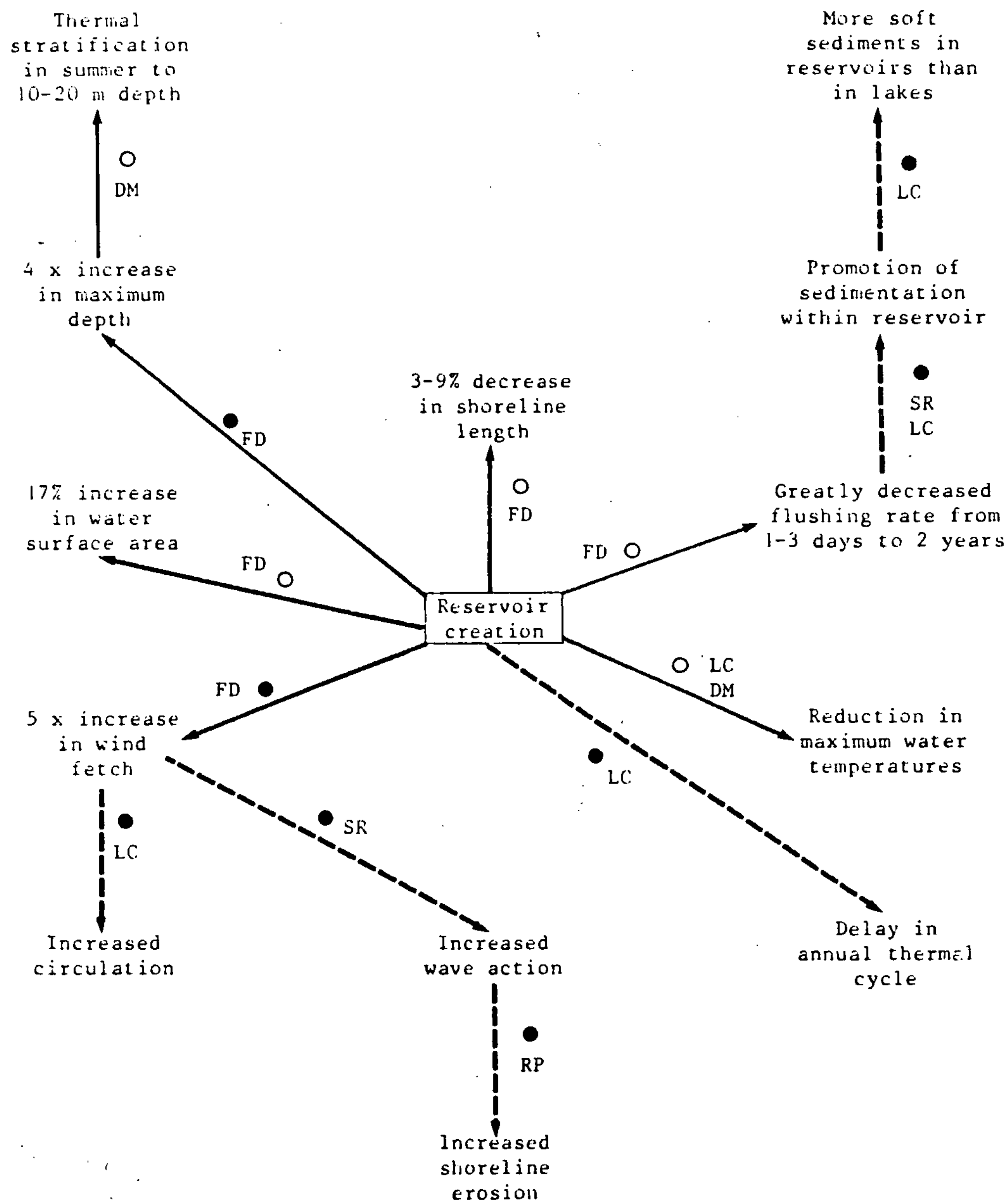


FIGURE 2 MORPHOMETRY AND HYDROLOGY: EXAMPLE OF AN AQUATIC IMPACT HYPOTHESIS TAKEN FROM THE EIS FOR THE CAT ARM PROJECT (Newfoundland and Labrador Hydro, 1980)

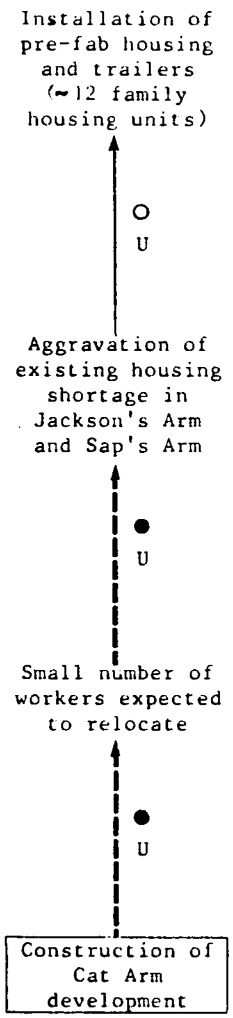


FIGURE 3 HOUSING: EXAMPLE OF A SOCIAL IMPACT HYPOTHESIS TAKEN FROM THE EIS FOR THE CAT ARM PROJECT (Newfoundland and Labrador Hydro, 1980)

TABLE 1 METHODOLOGIES USED IN RESPECTIVE EIS DOCUMENTS TO ESTABLISH THE INDICATED LINKAGES IN FIGURES 1 TO 3

1. Q - Qualitative --→ BROKEN ARROW
   D - Quantitative ⟶ SOLID ARROW

2. Context of statement - these are the letters typed by arrows
   - HM habitat/carrying capacity model
   - DM systems simulation (dynamic) model
   - SM statistical model
   - RP reservoir paradigm
   - BP boomtown paradigm
   - SB knowledge of species biology
   - SR standard reference text
   - EW experimental work
   - FD field data collection
     - FD1 ecosystem oriented
     - FD2 considered monitoring
   - U not documented or unknown
   - LC legend consequence

3. Testable/Not testable - these will be represented by circles on arrows } testable o, non-testable •

Not Testable (reasons)	Testable
. development changed (no longer relevant)	. qualitative comparison
. statement too vague	. statistical test
. no date	. probably could be tested but full information not given in reference
. too trite (obvious prediction)	
. data highly variable or unreliable	

Overview on Opportunities for Analysis

Aquatic Impacts

The aquatic information was organized into four categories: water quality, hydrology and morphometry, limnology, and fish. Where possible, predicted impacts in the reservoirs were considered separately from downstream effects.

In general, there was extreme variation in the quality and quantity of data for each of these categories among the EIS documents examined. Older developments generally do not have much pre-development quantitative information on any aspect of aquatic effects. Newer developments have more quantitative data, but studies seldom address all the links that make up a particular hypothesis. For example, it is relatively easy to collect quantitative information on physical/chemical aspects, and there are often quite detailed measurements of these parameters. However, information on the lower trophic level biological components (e.g., plankton, benthos) is harder to collect; therefore, studies tend to skip over these and focus more on the particular components of interest (e.g., certain fish species).

The most common aquatic impact hypotheses are those dealing with effects on water quality (e.g., changes in oxygen, temperature, thermoclines, and nutrient loads). Many of these hypotheses have opposite predictions depending on the type of development. In many of the newer developments, these hypotheses are relatively easy to test, because of the availability of quantitative information. The projects that offer the most fruitful opportunities for pre/post comparisons on water quality are: Upper Salmon, Cat Arm (1 year of post-development data), Wreck Cove, Eastmain-Opinaca, and Revelstoke. As water quality hypotheses form the basis of many impact predictions for other biological components (e.g., fisheries), they are particularly important for evaluation purposes.

In general, pre-development quantitative information on fish populations is very limited. While there are post-development data on fisheries in reservoirs, there are few cases where comparisons with the pre-development situation can be made. In addition, many of the hypotheses that deal with effects on fish are difficult or impossible to test because of the lack of information about the intermediate linkages in the hypothesis. Thus, most of the hypotheses about effects on fish populations will not be amenable to detailed analysis. The best projects for pre/post comparisons of predictions related to fish are: Churchill-Nelson Development (in particular South Indian Lake, Cross Lake, Cedar Lake), and Eastmain-Opinaca. Other sources of information, such as the agencies in the provinces responsible for managing lake fisheries, are being contacted to locate unpublished data sets on reservoir fisheries.

Terrestrial Impacts

For the inventory of impacts on terrestrial components of developments, predictions were grouped into five categories: geology, climate, air quality, vegetation, and wildlife.

Most geological predictions concerned effects on bank stability, shoreline morphometry, and groundwater effects. In general, these were qualitative predictions and not very suitable for pre/post comparisons. However, some post-development information on slumping and erosion effects is available from South Indian Lake, Eastmain-Opinaca, and Caniapiscau.

Impacts on climate were referred to in about 30% of the EIS documents. Effects included temperature modifications, changes in wind speed and direction, cloud cover, precipitation, and ice dynamics. Only one project (Centrale Rivière) examined changes in air quality during the development.

Most studies contained some predictions of effects on vegetation and wildlife. Vegetation losses due to flooding were often quantified. Other common impacts were vegetation alteration due to changes in downstream flow, microclimate, or groundwater regimes. Projects that offer possible pre/post comparisons for these impacts are: Cat Arm, Churchill-Nelson, and Mica.

Habitat loss or alteration as a consequence of flooding was commonly predicted to result in reduction in animal numbers through death and/or displacement. Projects that might be able to accommodate analysis of these impacts include: Upper Salmon, Churchill-Nelson, Seven Mile, and possibly James Bay.

Blockage of migration due to the reservoir itself, or to the operation of the development, was predicted to affect wildlife through direct death or displacement. Possible projects for follow-up analysis are: Upper Salmon and Revelstoke.

Impacts were also predicted as a result of disturbance during construction, or as a result of road-kills or other construction-related deaths. Projects that have a pre-construction data set and possibly some post-impoundment data are: Seven Mile, Upper Salmon, and Revelstoke.

Finally, impacts on wildlife due to increased access for hunters and fishermen were sometimes predicted, although rarely quantified. Surprisingly, this was not a common prediction, although most projects involve substantial improvements in road access. Projects that will accommodate some analysis are: Wreck Cove, Upper Salmon, Cat Arm, Seven Mile, and Revelstoke.

To obtain appropriate data for some of this analysis additional effort will be invested in contacting provincial wildlife agencies in the regions near to the appropriate reservoirs. However, data obtained from these sources will have to be carefully screened before analysis. Information, such as hunter statistics, is often heavily biased, and summarized by management unit rather than by watershed or reservoir area.

Socio-Economic Impacts

The inventory of socio-economic predictions was classed into categories that are generally accepted among social scientists and therefore allow meshing with existing social theories. These are: social, economic, demographic, fiscal, and public service. Aesthetics and heritage effects were not included in the inventory. The analysis of social effects is complicated by the fact that there is no widely accepted approach to social impact analysis. In any case, the issues raised are interesting and important, particularly for northern communities.

Within the categories defined above, there are two levels of predictions. First, there are those dealing with direct changes in the resources ("primary" impacts), such as effects on sport and commercial fishing, changes in hunting and trapping, and resource sector jobs. Second, there are those dealing with subsequent effects ("secondary" impacts), such as changes in taxation, public services, and other social impacts.

In general, Revelstoke has the most complete set of socio-economic impacts and data of any of the selected projects. Where possible, Revelstoke will be followed up to take advantage of this data set. Other projects with a strong emphasis on socio-economic impacts are the Churchill-Nelson development and the La Grande project (James Bay).

Those projects for which the best information exists for testing the "primary" impact predictions are: Churchill-Nelson, La Grande, and Seven Mile. In addition to these, the Churchill-Nelson project will be followed up because of that project's impact on native fisheries and wildlife.

The analysis of secondary effects is more difficult because factors other than those linked to the development confound the impact. By not attempting to analyze the secondary impacts, however, one loses information of great interest to the affected public and to the utilities themselves. Projects which could be examined to test these hypotheses are: Centrale Rivière, and Revelstoke (which has the most detail). Additional data could be obtained by contacting local public service agencies for unpublished statistics.

Analysis of Pre- and Post-development Data Sets

The second phase of the study focuses on determining the accuracy of pre-development predictions. To do this, the pre- and post-development data will be analyzed and compared, and the reasons for poor predictive capability evaluated.

Analysis Strategy

Because of the relative lack of data, the availability of post-development data is serving as the selection criteria for further analysis. Therefore, for those projects with post-development data, the specific components appropriate to predictions in the EIS will be analyzed and then linked to a generic framework. For each of these, the following information will be examined:

1) What exactly was the prediction? This is effectively contained in the diagrammatic representation of the impact hypotheses.
2) How was the prediction formulated? Each link within each hypothesis will be classified according to the method by which it was derived using the following categorization:

   - habitat/carrying capacity model,
   - dynamic model,
   - statistical model,
   - reservoir paradigm,
   - boomtown paradigm,
   - knowledge of species biology,
   - experimental work,
   - field data collection,
     - ecosystem-oriented
     - considered monitoring
   - standard reference text,
   - logical conclusion,
   - not documented or unknown.

3) What data was available to test the hypothesis? As part of the overall evaluation of the testability of the hypotheses, each link will be categorized to identify whether and why it is or is not testable, as follows:

Testable

- qualitative comparison
- statistical test
- possibly could be tested but not all information available

Not Testable

- development changed (no longer relevant)
- statement too vague
- no data
- too trite (obvious outcome)
- data highly variable or unreliable.

4) Was the prediction realized? Given a prediction can be tested, the appropriate analytic technique for pre/post comparison must be selected. As a guide for this stage of the study, a decision table was prepared that directs the analysis according to various criteria (Table 2).

Integration with Other Follow-up Studies

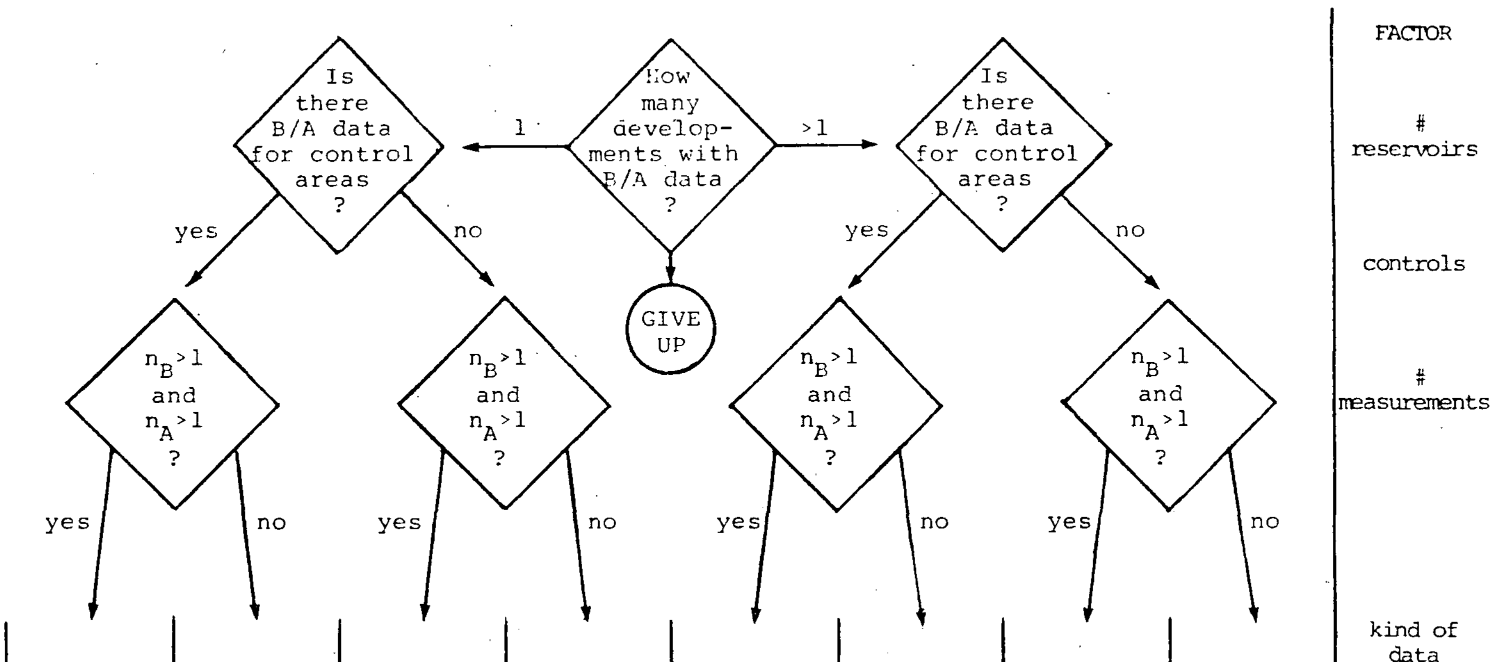
In recent years, there have been other follow-up studies designed to evaluate the effectiveness of the impact prediction process with respect to hydroelectric projects (e.g., South Indian Lake (Hecky et al., 1984), Eastmain-Opinaca, Outardes). This study should benefit from that experience, if possible extend previous analyses, and ensure their results are well-integrated. However, these analyses will not be repeated.

Preliminary Results

Why So Little Follow-up Data?

From the review of documents carried out to date, it is apparent that there are relatively few post-development studies available for comparison with pre-development studies. There are at least three reasons for this:

TABLE 2 FLOWCHART FOR DECIDING WHAT STATISTICAL TESTS TO USE



								kind of data
2-way ANOVA* (area * time) F-test is area * time/ error	no tests possible	t-test, or 1-way ANOVA if # time periods > 2	no tests possible	3-way ANOVA* (development * area * time) F-test is area * time/ error, or →	3-way ANOVA* (development * area * time) F-test is (area * time)/(dev. * area * time)	2-way ANOVA* (development * time) F-test is time/error	2-way ANOVA* (development * time) F-test is time/(dev. * time)	original quantitative data
transform data and use ANOVA (see Green example)		transform data & use ANOVA; Wilcoxon rank-sum test if n=2; Kruskal Wallis test if n>2		transform data to average normal deviates and use appropriate ANOVA				original rank data
3-D contingency table (see attached example)		2-D contingency table		4-D contingency table	no tests possible	3-D contingency table	no tests possible	original categorical or binary data

Notes

development = several reservoirs or run of river dams

*If n_B or n_A is > 1 and cover several years, each year should form a different level in the time effect.

Abbreviations used: B/A = before/after; n_B = # observations before; n_A = # observations after

1) usually compensation for the effects of development is awarded based on the EIS documentation. Therefore, interest groups have little motivation to fund follow-up studies. Often the projects that had a reasonable set of follow-up data (usually collected in the last 10 years), did not have a pre-project data set for comparison;
2) the development scenario is often modified after completion of the EIS, either through changes in the project engineering or through mitigation procedures. Thus, the post-development data may not be directly comparable to the pre-development information; and
3) monitoring is rarely treated as a high priority item. In the past, once a project was completed there was usually little interest in structuring expensive follow-up monitoring studies in and downstream from reservoirs. Only in recent years has the utility and importance of good follow-up data been more fully recognized.

Constraints to Prediction Evaluation

At first, it was hoped that a substantial amount of quantitative (i.e., statistical) evaluation of predictions would be possible as part of the study. However, as noted earlier, this is not proving to be the case. So far in our analysis there are four major constraints that have severely limited this option:

1) Use of control areas. Few studies (pre or post) include measurements taken in nearby control areas. This greatly restricts the type of statistical comparisons that can be done.
2) Unreplicated data sets. Most field studies within an EIA program were done only once; thus, it is difficult to control for the effects of an unusual year. It may be possible to partially rectify this by contacting the original researchers and asking for their assessment of the possible year to year variation.

   Another possible means of increasing the number of "replicates" to test a particular prediction is to compare across several reservoirs. In general, it was felt that comparisons involving two or more reservoirs are impossible in most cases because of wide differences in biogeography of the developments and because of the differences in the form of the developments themselves.

3) Time span of the studies. Changes in an ecosystem resulting from development may take many years to reach a new equilibrium. Many predictions do not clearly distinguish between short-term and long-term impacts to a particular resource. Wherever possible, the analysis will have to account for the time since development as an additional factor. Understanding the length of time a process requires to stabilize is as important to improving assessment methods as is predicting the level at which the process stabilizes.

4) Effects of mitigation. In several projects, mitigation procedures are instituted based on the predictions of the EIS. Where follow-up data exist, it may not be directly comparable to the pre-development studies because of the change in project design.

Need for an Ecosystem Approach

Nearly all of the EISs reviewed had a very disciplinary-oriented structure to the biophysical system. This usually resulted in poor integration across disciplines and minimal effort to develop an overall framework that could provide a focus for further study and monitoring.

There is definitely a need for a more integrated approach to assessment of hydroelectric projects. This is especially true for the social impact assessment component which is usually done in almost complete isolation from the environmental assessment. Given many of the potential impacts of hydroelectric development may eventually affect the local and regional people, it is critical that these two components of an assessment are better integrated.

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THE DERIVATION OF THE CANIAPISCAU RIVER UPPER BASIN: AN EXAMPLE OF GEOMORPHOLOGICAL MONITORING IN A SUBARCTIC ENVIRONMENT (QUEBEC)

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Nature of the Interventions

The Caniapiscau-Koksoak system encompasses the drainage of a 137 000 km^2 basin towards Ungava Bay in northern Quebec. The average river discharge generated by this basin is 2300 m^3/s, which makes the Koksoak the eighth largest river in Canada. The Caniapiscau-Koksoak river corridor, downstream from the headwater lakes, is 595 km in length and is situated between latitudes 54° 45'N and 58° 30'N.

To increase the hydroelectric production capacity of the La Grande Complex, the waters of the upper basin of the Caniapiscau River have been diverted towards the drainage basin of the La Grande River which flows into James Bay. This diversion was achieved by building a 54-meter-high dam at the same latitude as Duplanter Lake and by a series of dikes which have held back the water up to the 535.5 m mark in the Caniapiscau reservoir, allowing it to flow to the west by passing through control works. The area of the diverted basin covers 38 500 km^2; the average discharge added to the La Grande River is 810 m^3/s (Figure 1).

Filling of the Caniapiscau reservoir started on October 25, 1981. Discharge went down to zero immediately downstream from the dam and slowly rebuilt along the drained area and through the water yields of the tributaries. The reduction in discharge caused the water level to drop, the velocity of flow in the Caniapiscau-Koksoak river axis to decrease and in the downstream reach of certain tributaries to increase. These changes in the hydrology and hydraulics of the system have required physical environment adjustments which conform to the morphological particularities of the Caniapiscau-Koksoak river corridor.

Impact studies prior to the river diversion and the monitoring program that followed were sponsored by La Société d'énergie de la Baie James (SEBJ).

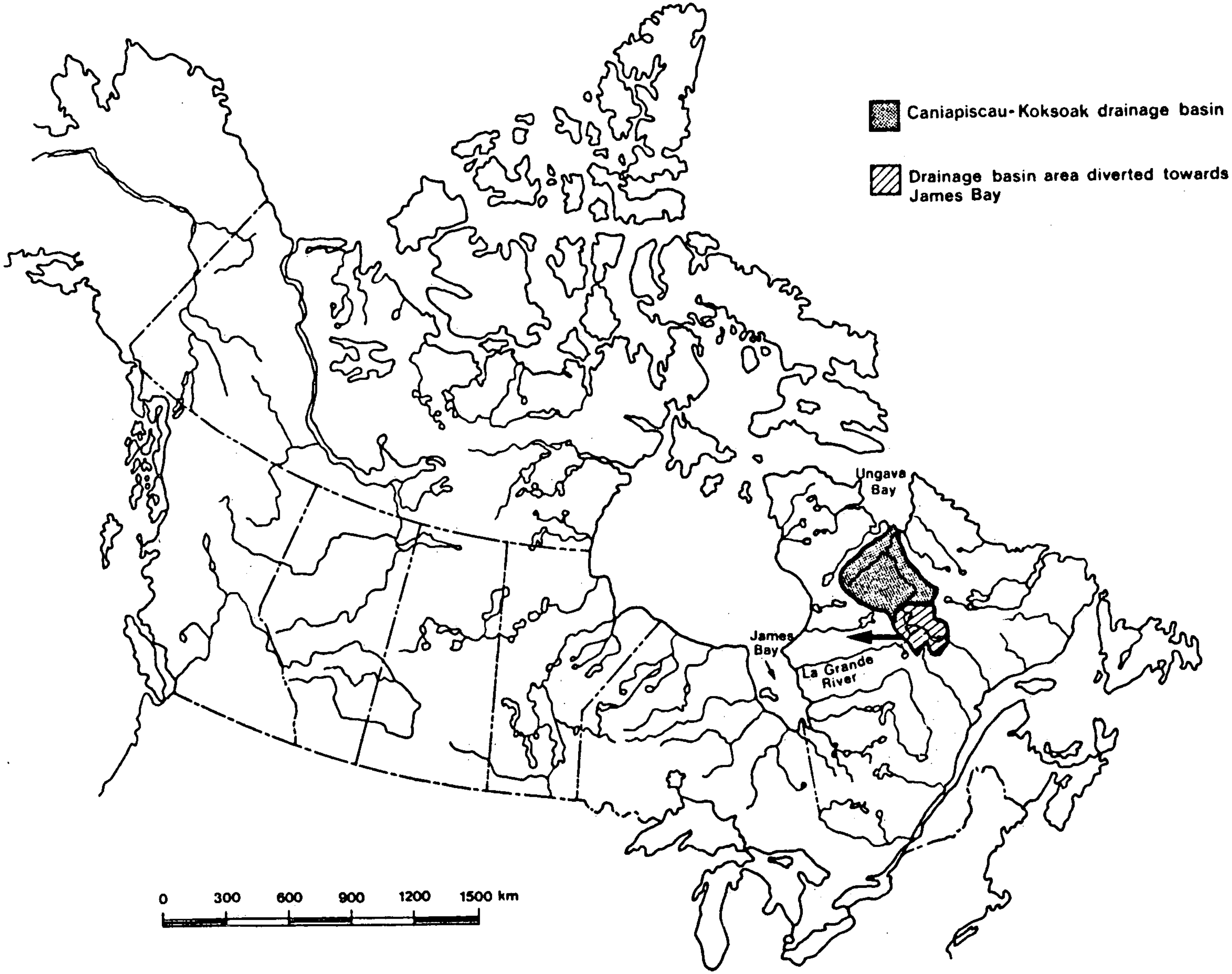

FIGURE 1 STUDY AREA

General Context

Topography, Climate and Vegetation

The drainage basin of the Caniapiscau River extends to the high plateau where the larger drainage basin systems of Quebec separate. Peaks measure between 700 and 780 meters high near the headwater lakes, whereas the depressions measure between 515 and 600 meters deep. Peak elevation decreases progressively towards the north to measure 300 meters near the mouth of Caniapiscau River and 100 meters near the coast. The surface configuration is generally between 150 to 180 meters high and is caused essentially by rock topography.

The Caniapiscau valley is under the influence of a subarctic continental climate whereas the northern half of the Koksoak valley has an arctic maritime climate. The average annual temperature is -4°C near the headwater lakes and -5°C in Kuujjuaq village situated approximately 50 km from the mouth of Koksoak River. The no-frost season lasts an average 60 days. The average annual precipitation varies between 800 mm at the basin head and less than 400 mm at the level of Kuujjuaq. Forty percent of the precipitation falls as snow. The prevailing winds come from the SSE and the NNW. The territory under study occupies a widespread zone of discontinuous permafrost (Brown, 1967). However, permafrost has not been found to exist on the immediate borders of the watercourses.

Most of the territory lies in the woody tundra zone, trees are found in the valleys only. Tundra (beyond the tree line) begins at approximately 25 km from the mouth of Koksoak River (Levasseur and Laframboise, 1978).

Regional Geomorphology

As elsewhere in the Canadian Shield, the surface of the old peneplain is scoured with large preglacial valleys. The unconsolidated material cover is thin and discontinuous on the high grounds but becomes quite thick in the valleys. The watercourses have cut their way through these postglacial deposits which influence the dynamic equilibrium of the river system. These loose deposits were laid down during deglaciation and the marine episode that followed, as well as during the subaerial evolution period which continues to this day.

The deglaciation of the coast of Ungava Bay occurred approximately 8000 years ago and the last traces of glaciation disappeared near the headwater lakes 6000 years ago. The postglacial sea reached a level of between 198 to

200 meters and penetrated the Koksoak and Caniapiscau river valleys up to Eaton Canyon, covering a distance of 440 km. The glacial front retreated on contact with seawater. The postglacial isostatic rebound caused the progressive emergence of the terrain and the entrenchment of the watercourses up to the sills that control the present water level.

The glacial deposits are composed of till and associated glaciofluvial deposits. This coarse material makes up almost all the loose cover in the Caniapiscau valley upstream from Eaton Canyon, or in other words, above the level reached by the postglacial sea. Due to the very high resistance to erosion of these deposits, the recently formed valley is very narrow, the banks are very steep and the longitudinal profile of the bed is very inclined which makes the water flow rapidly.

Immediately downstream from Eaton Canyon, or in other words, below the level reached by the sea, the material is arranged in terraces. The sand and gravel are the only unconsolidated material found in the first 80 kilometers. Silty clay appears on the circumference of Lake Cambrien which occupies a widening in the preglacial valley of the Caniapiscau River. There is very little silty clay in the Caniapiscau and Koksoak river valleys but it is found in abundance along the lower course of the tributaries. The section downstream from the Cambrien Lake is dominated by sand, which is silty in areas, and by gravel and rock.

The banks of Koksoak River are generally composed of a veneer of cobbles and blocks, or rocks. In general, the veneer of coarse elements is underlain by finer material deposited in a marine or deltaic environment.

Hydrography

The Caniapiscau-Koksoak river system is composed of headwater lakes, the drainage basin of which has been artificially grafted to that of La Grande's. Many important tributaries flow into Caniapiscau River; their basin covers an area measuring between 3000 to 16 000 km^2. Caniapiscau River flows into Larch River (a drainage basin of 42 700 km^2) to form Koksoak River that flows for a distance of 137 km before reaching Ungava Bay.

The total denivellation of the longitudinal profile of the river axis is 490 meters. This profile is shown in Figure 2. This figure also shows the points of confluence of the rivers with the tributaries. Note that the average gradient of the water surface is very inclined (1.5 m/km) in the first 150 kilometers, south of Eaton Canyon. Farther downstream, the denivellations consist mainly of five falls, namely Eaton Canyon, Granite Falls, Schistes Falls, Pyrite Falls and Calcaire Falls.

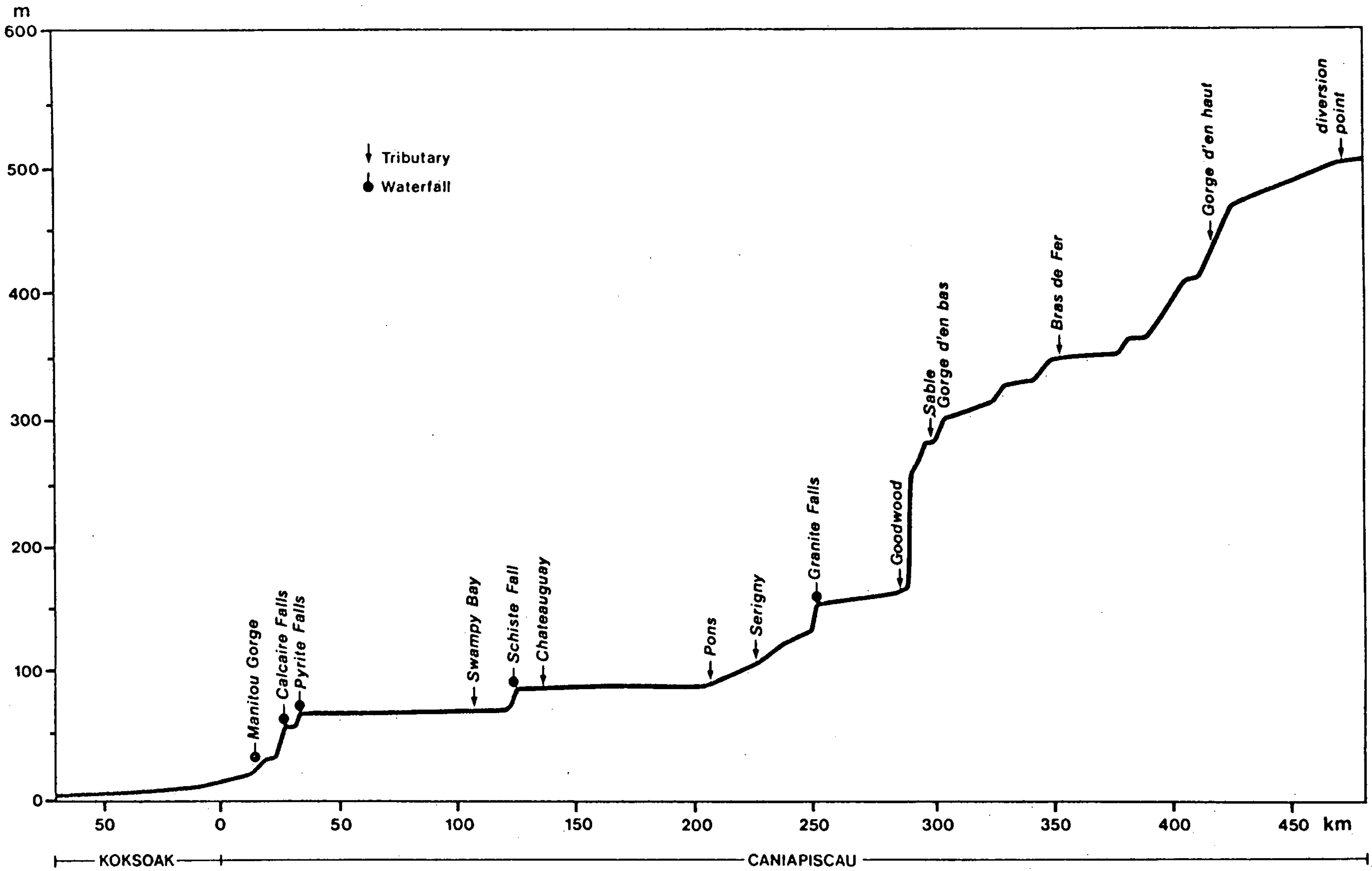

FIGURE 2 LONGITUDINAL PROFILE OF CANIAPISCAU AND KOKSOAK RIVERS

The water surface gradient is from very low to low between the fall lines except for a reach downstream from Granite Falls and in Manitou Gorge.

In this study, it is very important to take into consideration the longitudinal profile of the watercourses because the water surface gradient has a bearing on the rate of flow, which in turn determines the size of the alluvial deposits that make up the bed and the banks as well as the dynamics of the watercourses. The water surface gradient also influences the amount by which water levels drop following a reduction in discharge.

Population and Use of the Environment

Kuujjuaq (formerly Fort Chimo) is the only village in the area. It is situated on Koksoak River 50 km from its mouth and has a population of approximately 1150. In general, the Koksoak Inuits limit their exploitation on the environment to Koksoak River. A few purveyors exploit the fauna of certain tributaries of Caniapiscau River.

Changes to the River System

The diversion of an average discharge of 810 m^3/s brings about a reduction in discharge of 80% in Eaton Canyon, of 60% at the confluence of Châteauguay River and of 44% at the confluence of Larch River.

These decreases in discharge have caused a lowering of the average levels by more than 2 meters upstream from Eaton Canyon. This drop measures only 50 cm at Lake Cambrien due to the characteristics of the rocky control point of Schistes Falls. From these falls to the mouth of Caniapiscau River, the average level has fallen 70 cm. In the section of Koksoak River which is not affected by tides (a stretch of approximately 40 km), the average level has also dropped 70 cm.

The reductions in discharge have brought about velocity of flow decreases on most of the reaches. In the 150 km downstream stretch from the dam, the major velocity of flow decrease is linked to the shallow depth of water and to the roughness of the bed. On Caniapiscau River as a whole, the rate of flow has been cut in half except on a short section downstream from Granite Falls and in the Manitou Gorge where the geometry of the channel cross sectional area favours a very rapid flow.

The base level at the mouth of the tributaries is determined by the height of water levels in the Caniapiscau-Koksoak river axis. A drop of level gives inevitably a steeper gradient to the water surface and makes the water flow more rapidly in the part of the tributaries situated downstream from the first control point.

Follow-up on the Impacts on the Physical Environment

Follow-up Methodology

Gathering of data on the environment of the Caniapiscau-Koksoak river system began in 1981, a few months before the reduction in discharge. The work consisted of studying the composition of the beds and banks, the slope stratigraphy as well as the dynamics that governed the river environment under natural conditions. Fieldwork was preceded by a detailed photointerpretation of 1:10 000 scale aerial photographs taken in the summer of 1981.

Analysis of the aerial photographs and verification on the field enabled us to split up the area under study into zones that presented relatively uniform characteristics and that were likely to undergo changes of the same nature following the reduction in discharge on the Caniapiscau and Koksoak Rivers. Thus, 14 homogeneous zones were established: 9 on Caniapiscau River, 2 on Koksoak River; the remaining three correspond to the downstream reach of the three major tributaries (Larch, Swampy Bay and Châteauguay Rivers) (Figure 3). A geomorphological monitoring network was set up in the autumn of 1981 to measure the changes brought about in each homogeneous zone. A total of 60 reference sites were put in place. These reference sites were of two types:

> 26 reference stations were set up, consisting of a detailed topographical profile that intersects transversely with the shore between the top of the slope and the lower limit of the bank and a description of the texture of the material, of the stratigraphy and of the dynamics completes the survey;
>
> 34 reference marks consisting of stakes driven into the ground respecting a given spacing and are used to measure a particular phenomena such as the rate of erosion of a slope or the rate of progression of dunes.

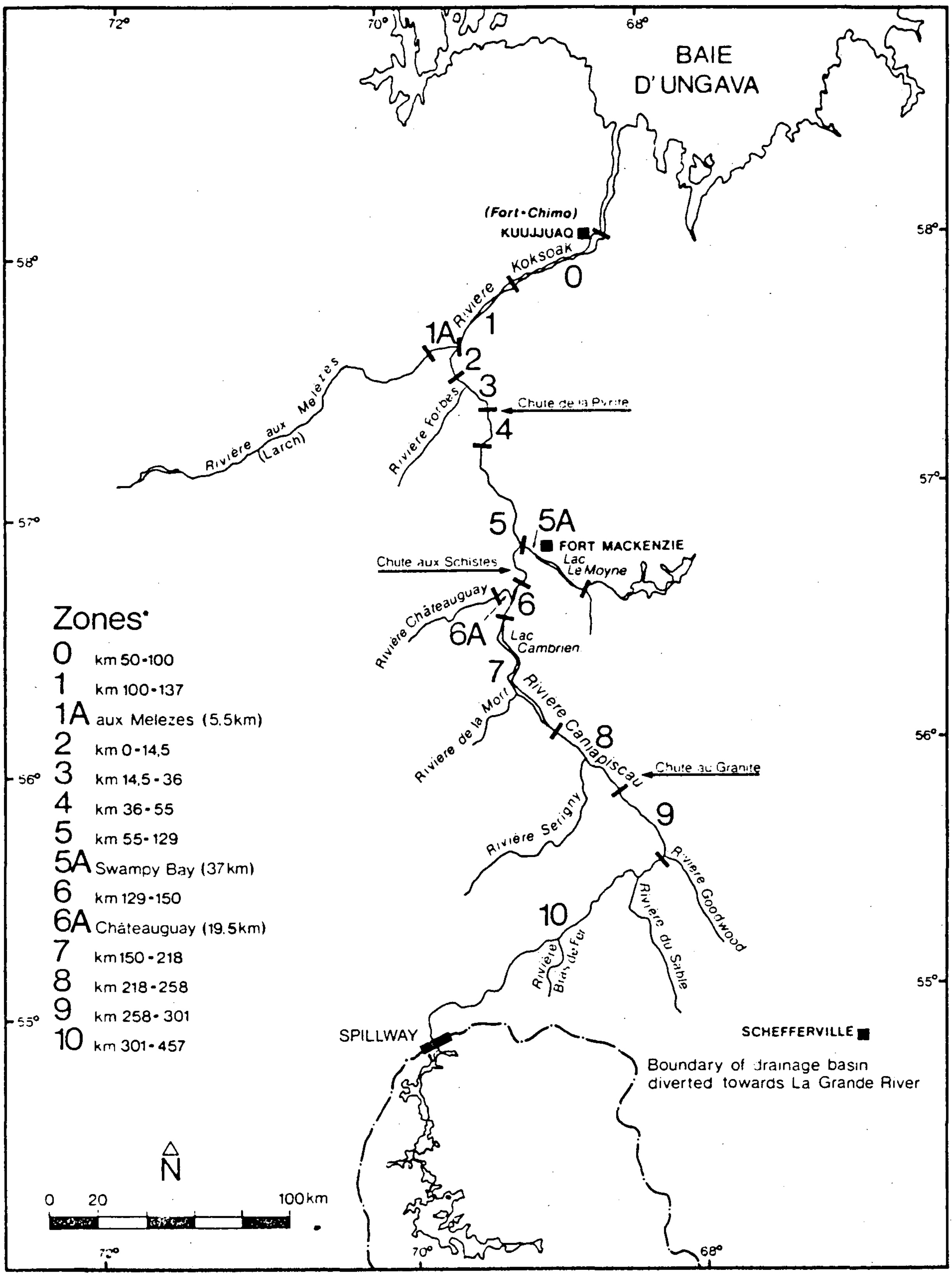

FIGURE 3 DISTRIBUTION OF HOMOGENEOUS ZONES

The monitoring network that covered the whole river corridor except for the marine estuary of Koksoak River[1] was operated for the first three years (1982-1984) that followed the diversion of the upper basin waters.

In conjunction with our work, the SEBJ took some water samples to measure the concentration of solids in suspension. These measurements were taken at six points along Caniapiscau River as well as at the mouth of the five major tributaries. From seven to nine samplings were taken annually at each point, generally during flood. These measurements, together with the daily discharge values, enabled us to calculate the sedimentary budget of the river system following the cut and to make certain comparisons with natural conditions.

Morphological Changes to the Main System

Slope Evolution

The fall in water levels and the reduction in the rate of flow have greatly reduced slope erosion. Measurements taken at the monitoring sites, completed by a series of visual observations, have shown that the sandy slopes in the homogeneous zones 3, 4 and 5 have ceased all measurable evolution. Most of the slopes that were active under natural conditions in zones 1, 2, 6, 8, 9 and 10 are in the process of stabilizing. Their annual rate of erosion varied between 5 and 20 cm according to the reference sites.

The clayey cliffs of Lake Cambrien (zone 7) remained active during the follow-up period. The average annual recessions measured at both reference sites were 45 cm and 148 cm. However, the fallen debris at the base of the slopes are no longer eroded by the waves. Consequently, the slopes are not as steep which should favour their eventual stabilization.

The rate of erosion measured, together with the length and the height of the active slopes has given an estimated annual volume of scree for each homogeneous zone (Table 1). The largest volumes ($\geq$15 000 m^3) were recorded in zones 1 and 7; this represents a reduction varying between 40 and 65% in comparison with natural conditions.

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1 The marine estuary of Koksoak River was not included in our study and was subjected to separate surveys performed by the SEBJ.

TABLE 1 ACTIVE SLOPES AND SCREE VOLUMES IN EACH HOMOGENEOUS ZONE

Zone	Zone Length (km)	Total Length of Slopes in Continuous Activity (km)		Estimate of Annual Scree Volumes (m^3)				Average Annual Scree Volumes from 1981 to 1984	Prevailing Nature of Scree
		Natural Conditions	After the Cut	Natural Conditions	1982	1983	1984		
1	37.0	11.05	3.7	35 000	10 000	20 000	15 000	15 000	sand
1A	5.5	2.90	2.9	25 000	25 000	20 000	20 000	22 000	silt and clay
2	14.5	5.15	2.5	15 000	5 000	5 000	8 000	6 000	sand
3	21.5	1.55	-	2 000	-	-	-	-	-
4	19.0	-	-	-	-	-	-	-	-
5	74.0	3.75	-	5 000	-	-	-	-	-
5A	9.0	1.05	1.5	3 000	6 000	8 000	10 000	8 000	sand
6	21.0	7.00	1.0	20 000	10 000	5 000	8 000	7 500	sand
6A	19.5	5.70	5.3	30 000	30 000	25 000	20 000	25 000	sand and clay/sand
7	68.0	5.25	4.5	50 000	40 000	25 000	25 000	30 000	silt and clay
8	40.0	1.90	0.3	5 000	-	-	500	200	sand and gravel
9	43.0	3.10	0.2	6 000	-	-	500	200	sand and gravel

Bank Evolution

The drop in water levels caused by the reduction in discharge has brought about the emergence of shoals now exposed to the action of subaerial processes. The area covered by the banks under these low-water conditions has doubled in zones 5, 7 and 9, where it has reached respectively 1300 ha, 1900 ha and 830 ha. The exposed shoals are made up of sand in zones 5 and 9 and of silty clay in zone 7.

The extent of the changes affecting the banks varies from one zone to the next according to their composition and the agents governing their evolution. Zone 10, situated immediately downstream from the diversion works is made up essentially of very coarse gravel and rock. Its evolution under natural conditions was linked to the action of floating ice. A reduction in discharge varying between 80 and 100% caused all floating ice activity to cease. Consequently, the bed and banks of this zone are totally stable. Their morphology changes slowly with the formation of tiny sand deltas at the mouth of the streams.

Wind action on the sands on the banks was heavy under natural conditions. The wind now blows over the expanded area and its effects have greatly increased. The topometric surveys taken at the reference stations in zones 5 and 9 indicate that the volumes of sand shifted annually measure approximately 200 000 m^3 for each of these two zones. The thickness of the layer of sand shuffled and sorted by the wind varies between 1 and 10 cm/yr and the progression of the dune front, which was already advanced, was from 10 to 30 cm/yr. The sand is blown towards the upper bank where it buries gradually the riparian vegetation.

The rate of change of the banks of fine sediment, found mostly around Lake Cambrien, is accelerating. Waves act on a lower level which has very little natural protection. Furthermore, the surfaces exposed by emergence suffer gully erosion especially at the waterway of small streams which cut up the terraces.

One last diversion effect felt in zone 1 particularly was due to the fact that ice scouring occurs on a lower level. Ice scouring of the lower bank, which is less protected by a veneer of coarse elements, makes it more vulnerable to current action during the remainder of the season.

The repeated topometric surveys taken at the reference stations made it possible to establish the average annual rates of erosion and sedimentation from the positive or negative elevation differences measured. In general, the banks were eroding except at the mouth of the tributaries. However, the rates of erosion were low, varying between 0.2 and 0.7 m^3 per linear meter of bank per year.

Despite the small amount of data available, it was possible to calculate by extrapolation the eroded volumes of the banks for each homogeneous zone. The higher volumes were recorded in zones 5, 7 and 9.

Morphological Changes to the Tributaries

The reduction in discharge of Caniapiscau River in 1981 and the consequent drop in water levels had rapid repercussions on the downstream reaches of the affluents. The evolution of a few major affluents followed close behind.

The bottom of Sand River (an affluent of zone 10) was restructured on a stretch of approximately 0.5 km from its mouth. The restructuring consists mainly of sand shifting downstream; this new bottom movement affected an area measuring approximately 35 ha in 1984.

The erosion of the sandy bed of Châteauguay River (zone 6A) began on a 3-km stretch from its mouth. This erosion caused the local uncovering of marine clayey silts. The increase in the rates of flow and the volume of the new sediment yields have brought about important modifications to the morphology and the size of the delta. Thus, the alluvial dunes formed by Châteauguay River have moved towards the center of Caniapiscau River and the size of the delta has increased by nearly 10 000 m^3 in 1983 and 1984. The layer of sand laid down since 1981 is between 5 to 35 cm thick. However, the hydraulic changes to the downstream reach of Châteauguay River have not yet caused bank and slope erosion to accelerate.

The bed of Swampy River (zone 5A) is made up of gravel, cobbles and blocks and has therefore resisted entrenchment. However, the high rates of flow in the 3-km downstream stretch have caused the erosion of the sand and silty sand banks and slopes. Slope recession has reached 3 meters in certain areas in a single year (1984). All the scree is carried to the mouth and settles on the bottom of Caniapiscau River or on the delta of Swampy River which was originally made up of pebbles and cobbles. The thickness of sand deposited since 1981 over the coarse material of the delta varies between 1 and 15 cm.

A rocky sill at the mouth of Forbes River (an affluent of zone 3) ensures the stability of its bed. Its sandy gravel delta, however, has been subjected to important morphological changes in the course of every year of the follow-up. The topography of the delta has varied annually on an average thickness measuring between 60 to 70 cm.

The bed of Larch River (zone 1A) is likely to be scoured in the long run. However, because of the very coarse composition of its bed and banks, the phenomenon is too slow to be perceptible in a four-year follow-up. No changes in environment dynamics were observed. This river has not formed a delta.

Changes to the Sedimentary Budget

The impact of the diversion of Caniapiscau upper basin waters on the sedimentary budget was evaluated from a series of measurements of the concentration of solids in suspension taken from 11 sampling sites. The period of study spanned the years from 1977 to 1984.

The results reached show that a major change has taken place in the sedimentary budget of Caniapiscau River following the reduction in discharge. The important decrease in slope erosion has contributed in reducing the amount of sediments carried by suspension. The water yields of the tributaries remain mostly unchanged, though they have increased in certain cases. However, the greater part of the alluvial deposits settle in Caniapiscau River because of the drop in the rates of flow.

The quantities of solids in suspension before and after the reduction in discharge are comparable. These quantities are generally low between 1 mg/L and 3 mg/L during the non-flood period and between 2 mg/L and 60 mg/L during the flood period. All the higher quantities were obtained from samples taken during flood near the mouth of tributaries that drain clayey basins.

In Caniapiscau River, the average quantities of solids in suspension carried in 1982 and 1983 have shown the following progression from upstream to downstream:

Zone 10, 50 km from the diversion works: 3000 t/yr
Schistes Falls: 38 000 t/yr
Pyrite Falls: 68 000 t/yr
Mouth: 145 000 t/yr

The calculated quantities demonstrate that the reduction in discharge has brought about a drop in the volume of sediments carried in suspension by over 85% upstream from Cambien Lake and by 55% at the mouth of Caniapiscau River.

Discussion of the Follow-up

The amputation of a portion of a river basin has inevitable repercussions on the hydraulics of the system. The hydraulics are, in a manner of speaking, the motor of river environment evolution and their effects depend on the sensitivity of the environment, more specifically the composition and geometry of the bed, banks and slopes.

Thus, in zones 8 and 10, where the valley developed in rock and in coarse glacial material, a major reduction in discharge was accompanied by a comparable reduction in the size of the watercourse without causing impacts, such as the sanding-up of the bottom or a subaerial change in the banks. In other zones, composed of material more vulnerable to transformation agents, the reduction in discharge had impacts that vary with the prevailing composition of the zone.

The impacts on the circumference of Lake Cambrien (zone 7) are linked to the emergence of large flats made up of clayey silt. Erosion of these flats is speeded up by wave action and subaerial agents. However, this accelerated rate of erosion of the banks is compensated by the slowing down of slope erosion and the budget of suspended matter added to the water has changed very little. Therefore, It is not necessary to recommend that any mitigation be taken.

In dominantly sandy zones (zones 5 and 9), the impacts are linked to the wind action on the banks that have been recently bared. The measurements taken during follow-up have shown that the wind shifted annually more sand in each of these zones than the Caniapiscau carries alluvial deposits to its mouth. Stabilization attempts using plants were made on the sandy banks to stem eolation should it start having consequent effects on the environment.

Since the reduction in discharge, floating ice acts on a lower, poorly protected level and has caused scouring and higher erosion of the clayey silt found in zone 1. The mitigation measures aimed at eliminating such erosion, which remains isolated, would be difficult to apply because of the inaccessibility of the territory by road and of the extensive use of this watercourse by the natives who would not permit the building of sills to raise the depth of the water.

The major impacts of the reduction in discharge and the drop in water level on the Caniapiscau River are felt in the downstream reach of the tributaries and on the bed of the main stem of the river downstream from the confluences. The surveys performed from 1981 to 1984 show that erosion of the bed or banks and slopes increased sharply on the downstream reach of many tributaries. The material furnished by the tributaries is quickly evacuated to the mouth and their accumulation changes continuously the morphology of the deltas and shoals. This new bottom mobility especially affects the immediate environment of the mouths, but also changes the composition of the bottom of Caniapiscau River on a stretch of a few kilometers downstream from the confluence of certain tributaries. The reduction in flow velocity of Caniapiscau River causes more sedimentation of finer particles than under natural conditions and all the more so since the sedimentary yields have increased.

The impacts caused by the increase in flow velocity in the downstream reach of certain tributaries could be neutralized by raising artificially the level of the natural sills to control the level of Caniapiscau River. Such control works were set up on the bed of the Eastmain and Opinaca Rivers, which are situated 560 km to the SW and are part of the La Grande Complex. Due to the silty clay composition of the basins of these two rivers, the creation of artificial sills checked erosion that had become acute and that had affected the sedimentary budget at the mouth. In the case of Caniapiscau River, the new sediment yields are coarser (silt and sand) and settle mostly not far from the mouth of the tributary. The raising of the level of Caniapiscau River would generate a higher sedimentation of yields of all origins and a faster change in the bed composition. Furthermore, the sedimentary budget of Caniapiscau River is low and its water transparency is not affected perceptibly by the new sediment yields from the tributaries. Their effects are therefore local and applying mitigation measures such as raising the sills would not be justifiable.

The follow-up of the morphological evolution in the Caniapiscau-Koksoak river corridor performed during the first three years following the reduction in discharge has allowed us to measure changes which have occurred on a short-term basis and to evaluate the trends that emerge relative to mid- and long-term evolution. It also shows that morphological changes incurred are minor except near the mouth of the tributaries. In such cases, bottom mobility and morphology undergo important changes. Concentrations of suspended material and water transparency have been little affected by the reduction in discharge.

In general, none of the changes measured on a short-term basis justified the application of mitigation measures. However, it is evident that the reduction in discharge changes the size of the watercourses affected as well as certain of their hydraulic characteristics such as flow velocity. These changes are linked intimately with the diversion process and cannot be corrected.

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ENVIRONMENTAL FOLLOW-UP TO ASSESSMENT AND MITIGATION FOR CONSTRUCTION IN ALBERTA

K.K. Exner
N.K. Nelson

Introduction

NOVA, AN ALBERTA CORPORATION operates a 13,500 km natural gas transmission system built up since 1957. NOVA has constructed more than 2,500 km of new, primarily small diameter (less than 273.1 mm or 10") pipelines in Alberta since 1980. Laterals cross all types of terrain, and have been constructed in summer and winter. Environmental assessments and protection plans have been filed for pipeline facility additions pursuant to regulations under Alberta's Land Conservation and Reclamation Act since 1980. These applications describe route selection factors, assess the expected impacts from construction, and present a plan to mitigate those impacts.

Follow-up to the assessment takes two forms - environmental inspection and special monitoring and research studies. Environmental inspection during construction facilitates plans and procedures, response to unplanned events, and feedback on utility of mitigative measures. Special monitoring and research studies provide an opportunity to evaluate project environmental planning in terms of the validity of the assessment process, the effectiveness of alternative mitigative measures, and the implication of various approaches on regulatory review. NOVA's Standard lateral, constructed in 1983 near Calgary, Alberta, is presented as a case evaluation of assessment and mitigation designed to minimize soil quality change due to pipeline construction.

Environmental Assessment and Planning for Pipeline Projects in Alberta

Environmental regulation of pipeline construction is essentially the same as in other Canadian jurisdictions.

Early efforts by government personnel in dealing with pipeline project applications were oriented distinctly towards route selection. It was recognized, quite rightly, that consideration of environmental parameters in project routing goes a long way towards avoidance of future environmental problems, such as pipeline breaks due to slope failure, or a lack of coordination of exploration, development and transmission phases. These considerations, together with the associated potential for impacts on timber resources and fish and wildlife populations, continue to be the factors of importance in the forested area of Alberta.

On the other hand, route selection in agricultural land never took on the same importance. Opportunities to accomplish something environmentally are limited to the "fringe" areas where agricultural and non-agricultural lands meet, and where small localized areas such as saline seeps can be avoided. The emphasis in applications for pipeline facilities proposed for farmland, particularly since 1983, has been on the collection of route-specific soil profile and chemistry data. The primary use of this information has been for specification of soil handling procedures. There has been considerable debate between Alberta government agencies, the industry and the consulting community, as to the appropriate level of detail of the original fieldwork conducted for this purpose, and on the applicability of various construction procedures to different soil types and field conditions. Alberta Environment has recently updated its information requirements in this regard, and released a guideline for soil handling procedures for pipeline construction.

The result of this kind of thinking on agricultural soil issues has been the establishment of a general trend in pipeline applications towards greater emphasis on plans and procedures. Description of the existing environment is important, but only insofar as these data and information can be used in developing procedures. The environmental assessment documents themselves are thus "lighter" on inventory and "heavier" on real assessment and mitigation than they once were. This is seen as a positive step, and one that is consistent with the development of an issues approach throughout the environmental impact assessment field.

Follow-up to Assessment

While a trend in environmental assessments for pipeline projects is recognizable, a similar pattern in follow-up studies and the subsequent use of results is not as evident. This is primarily because little written material dealing with the outcome of plans and procedures is produced and what is produced is often not for general distribution, but for company files. Environmental inspection in the field is left to the company representative dealing with the appropriate government agency officers. Day-to-day issues are dealt with verbally for the most part. Ideally, the level of follow through on plans should be related to the degree of concern for impact. In some cases, environmental inspection during construction and a short report are appropriate. In others, special limited scale monitoring and research programs are required to evaluate the utility of a specific construction procedure. Finally, environmental as-built reports, comprehensive evaluations of project planning and construction, are appropriate for complex, controversial or new situations. NOVA has carried out all three levels of follow-up on different occasions.

Environmental Inspection

Because of NOVA's ongoing and large construction program, full-time environmental inspectors are employed. This commitment is based on the recognition that environmental quality is lost at the implementation level easier than at the levels of planning and policy making.

Broadly stated, an environmental inspector's responsibility is to follow through on commitments made by the company at the application stage, and on terms and conditions of approvals. As with any construction inspection function, the objective is to ensure that what gets built is in keeping with contract specifications. This is primarily a surveillance function.

The environmental inspection task is only straightforward and predictable if everything goes according to plan. This is rarely the case, however, and the company inspectors have been involved in decision making in the following kinds of circumstances:

- wet weather shutdown in agricultural land;
- contingency topsoil stripping at dig-up locations when pipe or weld flaws are suspected;
- alteration of stream crossing construction technique to accommodate change in flow or in amount of spoil generated; and
- site specific reclamation and clean-up procedures.

This active involvement in the application of procedures in the field adds a monitoring/feedback dimension to environmental inspection activity that helps improve the quality of future work. The combination of a surveillance/compliance kind of focus with an element of evaluating designs and practices has been termed systematic monitoring (Yarranton, 1984).

When this field experience is available to project planning, changes in procedures sometimes result. In NOVA's case, one example has been the development of drawings and specifications for topsoil stripping at areas of widening and for construction during winter. Additionally, equipment such as a winter topsoil stripper and a hydraulically adjustable step blade has been developed in response to field observations on the effectiveness of techniques that were employed previously.

Environmental inspection also can contribute to effects monitoring, as defined by Duinker (1985) where predictions or mitigative measures are being tested. The case study which follows exemplifies this approach.

Monitoring and Research

Environmental impact assessment has historically been an activity that preceded development. Even though the activity is devoted in part to predicting change, Bisset (1985) points out that there have been few attempts to use projects as "natural experiments" in order to test the predictions, methods and techniques. Beanlands and Duinker (1983) observed that predictions in environmental impact assessments were often qualitative rather than quantitative, and the mitigative measures were often based on generalized principles.

One recent attempt to assess the impact of pipeline construction on agricultural soils by Hardy Associates Ltd. (1983) documented frequent burying or mixing of topsoil, poorer crop and pasture growth, and weediness on pipeline rights-of-way. The problem with a broad retrospective study such as this, is that it included older sites where topsoil conservation was not even practiced. This fact, together with the difficulty in recreating construction conditions and events, makes it difficult to critically evaluate the specific procedures that are in use today. NOVA is conducting a number of research projects that lend themselves to this experimental approach.

The Standard Lateral Case Study

Standard lateral is located in a grain farming district east of the city of Calgary, Alberta (Figure 1). It is a 19 km long 273.1 mm sweet natural gas pipeline. The environmental protection planning exercise concentrated almost entirely on the issue of soil handling methods in soils affected by soluble salts and/or sodium.

Planning

Farm lands over large areas of southern and central Alberta have soils affected by the presence of soluble salts and/or sodium. Pipeline construction in salt-affected soils has the potential to introduce saline or sodic subsoil from the trench bottom to the plant root zone (20 - 30 cm). The presence of salts, and especially sodium, in sufficient concentration may cause a change in soil structure

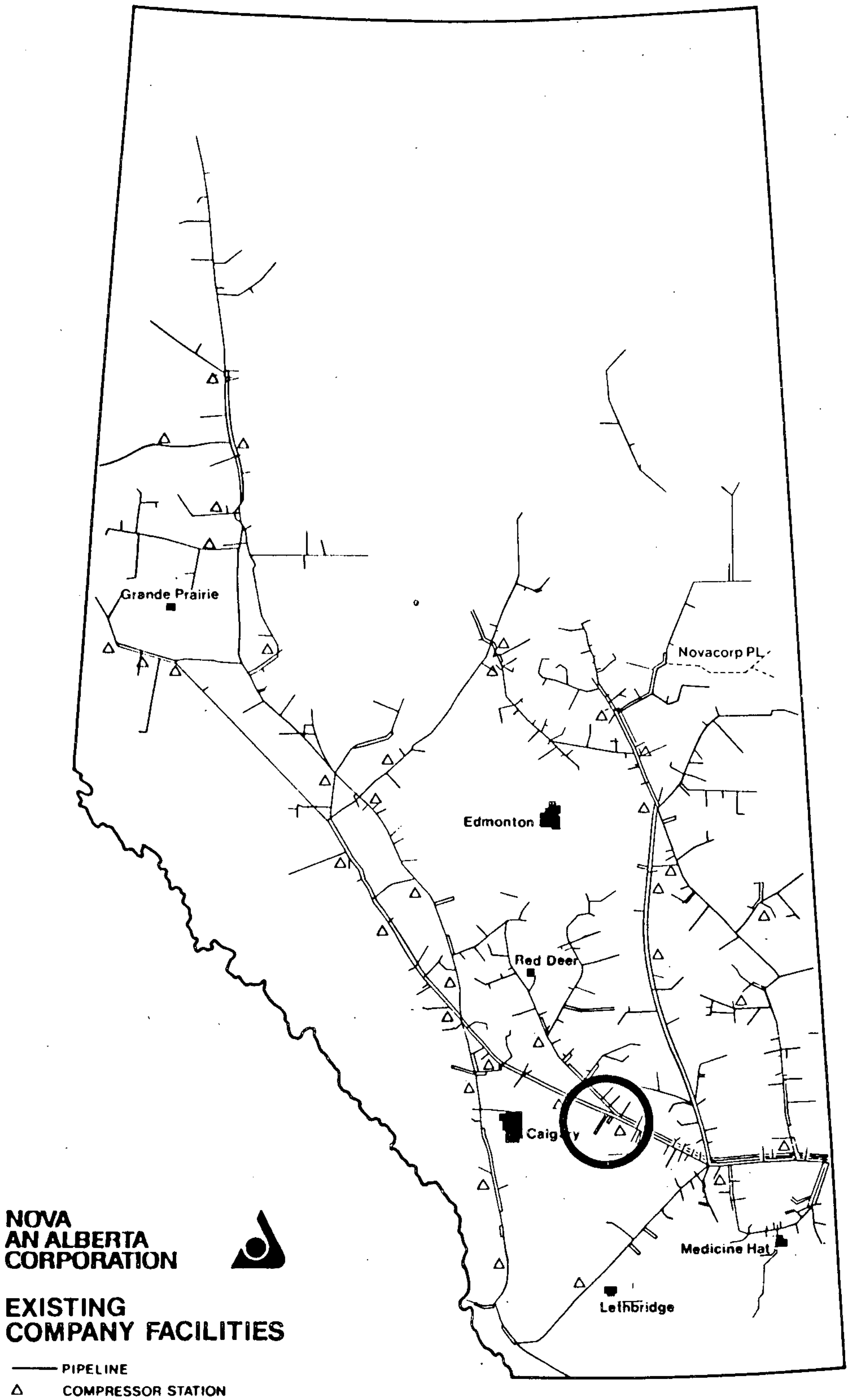


FIGURE 1 LOCATION OF STANDARD LATERAL

(dispersion). Dispersion changes the availability of soil moisture and nutrients and affects all stages of plant growth. The pipeline construction procedures which affect an increase in salts and sodium and the type of soils most susceptible to such change have been under discussion by Alberta Environment and the pipeline industry for some time.

The procedure which has been proposed to minimize the potential change in soil capability due to pipeline construction in saline/sodic soils is called three-lift soil handling. Two-lift soil handling, NOVA's conventional method in agricultural land, calls for separate removal, storage and replacement of topsoil (usually, 15 - 30 cm) and subsoil (to 125 cm trench depth). Three-lift soil handling calls for separate removal, storage and replacement of topsoil, non or weakly saline/sodic subsoil and then of significantly more saline/sodic subsoil. Having decided to scientifically evaluate the relative utility of two versus three-lift soil handling, NOVA's first task was to decide which soils could potentially benefit. Three basic criteria were developed.

1. Chemistry. Soils where key parameters fell in poor or unsuitable categories according to criteria published by the Alberta Soils Advisory Committee (1981) were identified as potential three-lift candidate soils (Table 1). It was recognized that these criteria, developed for reclamation of spatially extensive and deep disturbances such as mining, may not be applicable to shallow, linear disturbances. They were used nevertheless, as a first approximation.

TABLE 1 EVALUATION OF SUBSOIL QUALITY - KEY PROPERTIES FOR STANDARD LATERAL

	Index or Measured Value			
Property	Good	Fair	Poor	Unsuitable
Salinity (E.C.)	<3	3 - 5	5 - 10	>10
Sodicity (SAR)	<4	4 - 8	8 - 12	>12

2. Horizonation. Where poor or unsuitable material was found between 40 and 80 cm in the soil profile (Figure 2), a three-lift operation was considered.

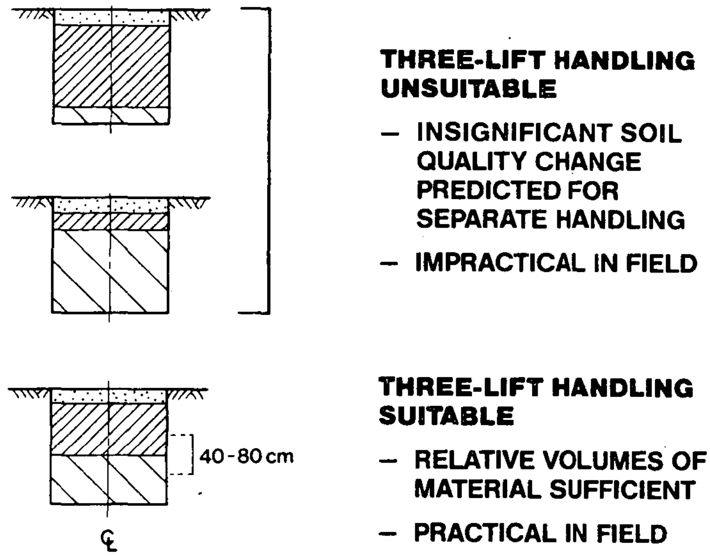


FIGURE 2 HORIZONATION

Some situations existed where undesirable material already existed near to the surface (such as lower slope positions), and at the other end of the scale there were locations where the bottom of the trench just barely approached the undesirable material. Such areas were rejected from consideration for the three-lift procedure.

3. Linear Extent. For ease of application of procedures in the field, 800 m (approximately the distance across one quarter section of land) was arbitrarily established as a minimum distance considered for three-lift soil handling.

Having developed and applied evaluation criteria for Standard lateral soils, it was decided that three-lift soil handling should be considered for three separate areas totalling about 2600 m of the right-of-way.

Construction

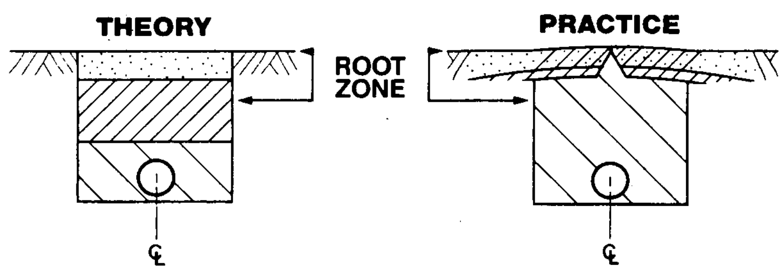
Two-lift soil handling was carried out using a conventional bucket-wheel ditcher. After topsoil was stripped, subsoil was excavated to a depth of about 125 cm and stockpiled in the spoil storage area. A backhoe was used for two-lift soil handling at road and railway crossings, foreign pipeline crossings and sidebends.

Backfill of the two-lift areas followed the conventional specification. A power auger was used to replace material to within about 25 cm of the top of the trench. A Caterpillar Model 16 grader then compacted the fill with its tires and bladed in the remainder of the spoil and compacted again. A small volume of the mixed subsoil overflowed the ditch proper and was feathered out over the centreline. Topsoil was replaced over the spoil storage area and ditchline.

Where three-lift soil handling was specified the contractor ran two bucket-wheel ditchers, one in front of the other. The first ditcher (the second lift of a three-lift operation) excavated midsoil from about 15 cm - 50 cm in the profile and windrowed it on the travel side of the right-of-way. The second ditcher (the third lift) excavated lower subsoil from about 50 cm to 125 cm (trench depth) and placed spoil on the spoil side.

This ditching operation did not cause delay of other construction operations. The contractor took the precaution of ditching well ahead of the welding and lowering-in operations. Had there been wet weather during construction some problems may have occurred.

Backfilling in the three-lift plots did not work as originally conceived (Figure 3). The lower subsoil substantially filled the trench despite ideal operating conditions for the power auger, and one compaction pass with a grader wheel. As a result, the midsoil was placed in the location specified for topsoil and bladed out in a 2 m swatch centred over the ditchline. Some mixing of lower subsoil and midsoil resulted from this operation. Replacement of topsoil over the feathered midsoil appeared to result in mixing of those two layers. In areas where three-lift soil handling was accomplished with a backhoe, the same backfill procedure was used and the same end result was observed.



1. POOR SUBSOIL FILLS DITCH – GOOD SUBSOIL IS PLACED ON GRADED SURFACE.
2. TOPSOIL MIXES WITH GOOD SUBSOIL DURING TOPSOIL REPLACEMENT.
3. ROW CULTIVATION CAUSES CONTAMINATION OF TOPSOIL AND ROOT ZONE WITH POOR SUBSOIL.

FIGURE 3 FIELD OBSERVATIONS

Monitoring

Within the area chosen for the three-lift procedure, plots were established for comparing two-lift and three-lift treatments. Soils in the area occur as intricate mixtures of Chernozemic and Solonetzic pedons over distances of a few metres. It was therefore necessary to do a detailed survey, using a truck-mounted drill, in order to classify soils within the designated three-phase areas and ensure that treatment areas were homogenous. Soil survey of the plots, sampling during construction and follow-up sampling was contracted to Pedocan Land Evaluation of Edmonton.

Electrical conductivity (EC), concentrations of calcium, magnesium, sodium, sulphate, the sodium absorption ratio (SAR), and saturation percentage were the key parameters measured. The main objective of construction monitoring and follow-up sampling was to evaluate differences in soil quality attributable to two-lift and three-lift soil handling during pipeline installation. This included an evaluation of construction procedures, comparison of treatments, and comparison of treatments to controls.

Results from sampling during and immediately after construction (Knapik, 1984) showed that the three-lift excavation procedure was effective in separating poor quality subsoil from the upper horizons. Sampling of soil stockpiles immediately after trenching indicated the midsoil material had substantially better quality than either the lower subsoil or mixed subsoil. However, the benefit of this separation was lost on backfill. Because of the bulking factor associated with excavation, and displacement caused by the 273 mm diameter pipeline, lower subsoil essentially filled the trench. Placing midsoil over this material, and then cultivating the right-of-way on cleanup, resulted in values for key chemical parameters in the 20 to 30 cm depth in the three-lift trench, being no different than values in the two-lift trench. Small, but significant differences in salinity and sodicity in the 0 to 20 cm depth of post-construction, trench soils were attributed to the incorporation of some midsoil into topsoil during cleanup cultivation of the right-of-way.

The plots were sampled again one year after construction (Knapik, 1985). Comparisons of two-lift and three-lift trench soil showed statistically significant differences between treatments for a few soil parameters. The differences in soil quality attributable to the soil handling procedure appear to be negligible when mean values of the key quality characteristics are compared. Mean values of pH, EC and SAR in the 0 to 10 cm depth fall into the same soil quality categories (good or fair) regardless of treatment. However, the two-lift soils do have values in the next lower quality category more frequently than do three-lift soils.

Comparison of two-lift and three-lift trench soils to control soils one year after construction shows that the magnitude of differences in EC and SAR are less than they were immediately after construction. This would suggest that differences in key soil properties due to pipeline construction are becoming less pronounced.

Results for one of the key parameters, EC, are summarized in Figures 4 and 5.

Only one of the study's three plots was located in a cropped field the year after construction. Yields measured in that plot in 1984 were significantly lower on the right-of-way than off, but the right-of-way yields did not differ significantly between the two-lift and three-lift treatments. This would suggest the lower yield on the right-of-way is independent of these treatments.

An attempt at this time to pass conclusive judgement on the value of the three-phase method for protecting agricultural soil quality is premature. While significant differences occur in key topsoil parameters between two-phase and three-phase areas (that favour the three-phase method), those differences do not change the soil's suitability ratings. Moreover, it is evident that the root zone area immediately below the topsoil was not protected from elevated salt concentrations as was intended with the three-phase technique.

Finally, it is important to note that differences in soil properties due to pipeline construction appear to be becoming less pronounced over time in both the two-lift and three-lift areas.

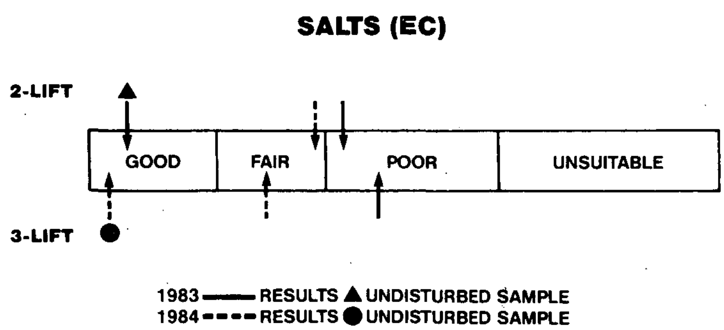


FIGURE 4 COMPARISON OF TRENCH SUBSOIL (20-30 cm) QUALITY AFTER TWO-LIFT OR THREE-LIFT SOIL HANDLING

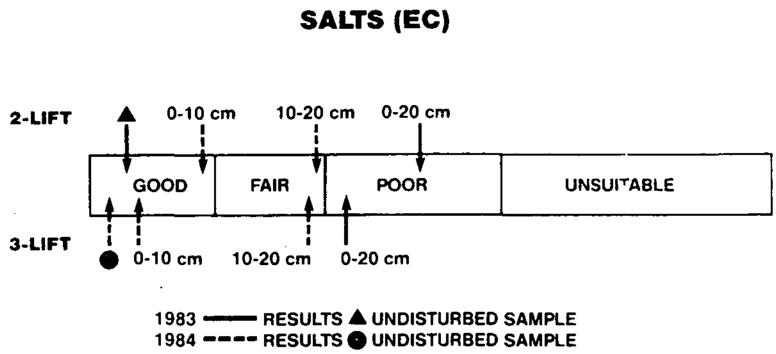


FIGURE 5 COMPARISON OF TRENCH TOPSOIL QUALITY AFTER TWO-LIFT OR THREE-LIFT SOIL HANDLING

The study is continuing because of the strong influence of the soil moisture regime over salt concentration, and in order to collect reliable crop yield data.

Planning Implications

NOVA's Standard lateral case study is offered as an example of a follow-up study designed to check the effectiveness of mitigative measures. It was important to conduct the study because the mitigative measures were contentious. Three-lift soil handling requires increased equipment use, more right-of-way, and hence costs more. It was possible to initiate the study because a reasonable base of data on the project site's soils had been collected. An experimental design was developed prior to construction, and key observations and measurements were made during and after construction.

In retrospect, some lessons for planning for similar situations can be learned. The overall approach at the application stage could have been more quantitative. Even though soil chemical parameters were compared to reclamation suitability criteria, and consideration was given to the practicality of the three-lift procedure in terms of linear distance and the relative volumes of material to be handled in each of the lifts, no attempt was made to predict the concentration of key constituents in the re-structured soil. Similarly, while the question of carbonates and whether there may be enough calcium in the lower part of the profile to ameliorate the effects of sodium was addressed in general terms, no predictive calculations were attempted. Finally, the importance of soil bulking factors and displacement due to the pipe were not recognized at the planning stage. Calculation of these factors would be of value whenever selective material handling on pipeline construction is proposed.

There are implications for the regulatory process as well. Neither the project proponents nor the application reviewers have been quantitative enough in their approach to predicting or mitigating environmental impacts from pipeline construction. Pipeline project applications are submitted with well known mitigation techniques and sound environmental planning and construction practice as the mainstay of their environmental protection plan. Reviewers occasionally respond with a letter listing deficiencies if they consider some important item has been overlooked; more often, however, the response presents a list of "concerns" that the applicant is asked to address. Typically, these concerns are difficult to address within the scope of assessment that is feasible preceding the project. A prerequisite to the solution of environmental problems in the future is the translation of concerns into predictions, and predictions must be based on pertinent data. Industry and government both have the responsibility to identify data gaps, and to present their case on an environmental issue in a quantitative way.

Given the results beginning to come from this study on NOVA's Standard lateral, and other work done for Alberta Environment, it will be possible to re-evaluate soil handling procedures for pipeline construction. This closes a feedback loop from follow-up to project planning. If, however, the areas with potential for conducting this special procedure are small, and if the benefit is indeed marginal, then the expense of collecting detailed soil chemistry data when surveying pipeline routes may be questionable.

Conclusion

Environmental assessment of pipeline development in Alberta has undergone a noticeable change in the last five years. Where early emphasis was on route selection, more effort is now being put into construction and reclamation procedures. Assessment documents are as a result lighter on inventory or description of the existing environment, and heavier on environmental protection plans.

While a common theme in the EIA literature is the lack of follow-up to assessments, this is occurring in the pipeline industry. Follow-up takes the form of environmental inspection as well as special monitoring and research studies. This paper illustrates that environmental inspection, in addition to having a direct influence on the success of environmental protection measures in the field, can result in improved plans and procedures being put in place for future jobs. Similarly, special monitoring and research studies are useful in pointing out the relative merits and success of assessment approaches and particular mitigative measures.

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ENVIRONMENTAL ASSESSMENT, MONITORING AND SURVEILLANCE OF THE NORMAN WELLS PROJECT WITH PARTICULAR REFERENCE TO FISH AND WATER QUALITY: DOWNSTREAM PERSPECTIVES AND CONCERNS OF THE DENE NATION

Fee-Yee Consulting Ltd.

Introduction

This paper addresses the concerns of the Dene with water quality and fish as related to the Normal Wells Expansion and Pipeline Project. Many of these concerns came to a head during the construction period (1982 - 1985) but will remain for the life of the project and after. This is an evaluation of the environmental assessment, monitoring and surveillance on the project, done from the perspective of the traditional resource users of the Mackenzie Valley. It specifically addresses questions of the predictive capability of project EA's.

Background

The Dene are the aboriginal inhabitants of the Mackenzie River valley and delta. Over 12,000 of them live in 26 communities in the western half of the Northwest Territories. They have depended on the renewable resources provided by the land and the water for thousands of years. The water is particularly important because all the animals and fish depend on it.

The Dene continue to hunt, trap and fish; they depend heavily on fish and wildlife for food and income. Even those involved in the wage economy often harvest renewable resources on a part time basis or use country food from others who do. For instance, in Fort Good Hope, a Dene community of 500 on the Mackenzie River, country food, including fish, comprises approximately 80% of meat consumed (DeLancey 1984) and over $150,000 is earned annually through fur sales. Those involved in assessing such levels of dependence agree that all such statistics are low. Many Dene feel that they will still depend on the land's resources once the current oil and gas boom is over.

Through their political organization, the Dene Nation (formerly the Indian Brotherhood of the NWT), the Dene are negotiating an aboriginal rights agreement with the Federal Government. Many aspects of management and decision-making affecting the land, water and wildlife are subject to those negotiations. The Dene have consistently and publicly maintained that no major non-renewable resource development should proceed on the land under claim prior to such a settlement (for example at the Berger Inquiry and at several National Energy Board and Environmental Assessment Panel hearings). They have repeatedly stated that they need to be meaningfully involved in the control, management and monitoring of such projects in order to protect the land from permanent damage, maximize the economic benefits to their people and minimize the inevitable negative social impacts.

By 1981, however, it was clear that the Norman Wells Expansion and Pipeline Project, proposed by Esso Resources and Interprovincial Pipelines Ltd. (IPL), would be approved regardless of Dene opposition. The Dene leadership therefore decided to "cut their losses" and make the best deal possible. They gave their conditional acceptance to the Project. One of the conditions was:

> "That a Monitoring Agency be established with Dene participation and funding provided to the Dene by the Government of Canada; and that the Monitoring Agency be given the authority to enforce compliance with rules, regulations, and agreements required to minimize impacts and protect or improve the environment."

Despite verbal commitments from the Minister of Indian Affairs and Northern Development to a significant Dene role in monitoring, this has not happened. As a result, the Dene have felt left out of the monitoring and surveillance of project construction. Through their own lobbying and research, and the support of a minority of government officials, they have succeeded in carving out a small role in the ongoing post-construction concerns. These include oil spill contingency planning, fish studies and water quality monitoring. But this role is largely unrecognized by the Department of Indian Affairs and Northern Development (DIAND) and the National Energy Board (NEB) which are the two major regulators. It is completely voluntary and non-regulatory; it fails to recognize that the Dene have aboriginal rights to the land and water being affected; and it does not respect the reality that they have the largest stake in the long term health of the environment and the capability of being involved in its management and monitoring. The situation is therefore still unsatisfactory.

This paper documents how this point has been reached through the evolution of several issues related to fish and water quality on the Mackenzie River system. A table showing the regulatory and non-regulatory agencies involved in the Project is attached as an Appendix.

Overview of General Concerns

Because of their dependence on fish and water resources, the Dene expressed concerns about the effects on them throughout the processes leading to the approval of the Project. They made such representations to the Norman Wells Environmental Assessment Panel (EAP) in the summer of 1980, the National Energy Board (NEB) in the fall of 1980 and the NWT Water Board in 1981. The following are examples of the kinds of general comments made at the community hearings of the Water Board:

> "People...have depended on this river for thousands and thousands of years...It's their livelihood. Some of the elders that have spoken in our assemblies and our public forums have said that this river is like, is like their blood."
>
> Herb Norwegian
> Dene Nation Vice Pres.

> "...we see something like Norman Wells Expansion Plan and that doesn't look too good to us. People start to worry...They probably have fear to drink water, they probably have fear that their fish will be gone."
>
> George Blondin
> Fort Franklin

> "Maybe we do not believe you when you say that a little of chemical or a little of metal thrown in to the water wouldn't destroy any fish, but we do know that it will damage fish."
>
> George Blondin
> Fort Franklin

> "...I don't study for fish like white people do, but know what it's doing. Because I live with it...and now all the things they said they're going to put in the water maybe goes down in the river, all the fishing is going to be stopped. They say it's not going to go that far but the fish will tell us."
>
> Jim Pierrot
> Fort Good Hope

More specific issues related to fish and water quality were also raised by the Dene at the pre-approval hearings. These included:

- oil spill contingency planning, including clean up capability in ice-covered or ice-infested waters;
- effects of oil spills on fish and water quality;

- effects of drilling wastes and refinery effluent on fish and water quality;
- insufficient baseline data on fish habitat, migration routes, etc.
- effects of blasting, trenching, dredging and siltation on fish;
- possible blockage of fish movements by construction;
- fish habitat alteration;
- increased access, and
- cumulative and sub-lethal impacts related to the above concerns.

In addition to the specific concerns raised, the Dene expressed the need for involvement in monitoring and in setting standards. They felt that the north was a special and delicate environment, and that people's relationship with ecosystems was more direct. It should be protected by higher standards than in southern Canada.

Each of the three hearings processes resulted in a report and/or a license of some kind. The Normal Wells Environmental Assessment Panel Report (January 1981) included many of the Dene concerns in its recommendations. However, these were not binding on any regulatory body. The NEB Report (March 1981) put much less emphasis on such concerns. The Board's Reasons for Decision and subsequent Certificate of Public Convenience and Necessity contained no reference to Dene involvement in monitoring. This latter was the single strongest regulatory document on the entire Project. The terms and conditions were vague and several environmental studies related to fish and water were not required from IPL until after approval. The NEB has proven to be unresponsive to Dene concerns and difficult to work with. The Government of the NWT has expressed similar frustrations in dealing with the most powerful regulator of the Project.

The Water Board held the most extensive and responsive set of hearings and issued licenses for Esso's Expansion Project and IPL's two major river crossings. These licenses contained many provisions designed to address and mitigate impacts raised at community hearings. However, the Board has no inspection staff or enforcement powers of its own.

Before addressing the specifics of these issues, it should be noted that it is too early to assess the long term effects and cumulative impacts of the Project. There are already some indications worthy of concern, but in the meantime, it is the processes involved, as well as the substantive concerns, that can be evaluated. Unless these processes change, there is no reason to expect more accurate predictions or better response to local and unanticipated concerns on the next project.

Specific Concerns

Inadequacy of Baseline Data

The lack of baseline data on fish in the Mackenzie was raised by the Dene and by the Department of Fisheries and Oceans (DFO) at the Norman Wells EAP hearings. The Final Report states clearly:

> "...that the Proponents consult with the Department of Fisheries and Oceans to address any outstanding fisheries concerns and demonstrate in their construction timing and techniques that they have used the available information and addressed the concerns."

As noted above, however, the Panel had no regulatory authority; it seems that this recommendation was ignored by those that did. The NEB did not follow up on it. Its report does not mention consultation with DFO, nor does it require IPL to use what data is available. The only requirement made was that any new information be submitted for the Board's approval only; i.e., not the approval of DFO. DFO did not have intervenor status at the NEB hearings.

Prior to construction, DFO received a verbal and voluntary commitment from Esso to undertake sampling of fish flesh downstream from Norman Wells. Esso did collect some samples but no analysis was done. Just recently Esso took some more fish at Norman Wells and sent them to DFO for testing. This was only after two years of lobbying pressure and was still voluntary on Esso's part.

No regular data-gathering is done on Mackenzie River fish and very little is known about populations, migration routes and habitat by the monitoring agencies. The patterns, cycles and health of the fish are well known by the Dene who use them. However, this knowledge is considered "non-scientific" and was not taken seriously by either the regulatory bodies or DFO. It will be explained in more detail below how it was local fishermen, not government monitors, who first noticed changes in the fish.

More complicated information on possible effects of construction activities on fish and on the long term, cumulative impacts is essentially non-existent. Even if serious research were to be undertaken now, the opportunity to establish a pre-project baseline has been lost.

As far as water quality goes, there is no baseline information on hydrocarbons or other organics in the Mackenzie prior to or during construction. Monitoring surveys for organics began in the summer of 1985 and will continue for 2 - 3 years, when the need for them will be reassessed. This monitoring is considered by the Inland Waters Directorate of the Department of Environment (IWD/DOE) to be 'state of the art' and they will be learning as they go along. Even if it is the most comprehensive and sophisticated testing available, it began six months after construction ended; there is no baseline with which to compare results.

There has been monitoring for non-organics done since 1960 by the Water Survey of Canada. This has been done six to twelve times annually at stations at Fort Providence, Fort Simpson, Norman Wells (upstream of Esso's operations) and Arctic Red River. It covers physicals, such as major ions, nutrients, metals and suspended sediments, but not organics such as hydrocarbons.

Similar problems existed with regard to oil spill contingency planning and clean-up capability. This applied to both the companies involved and the government regulators. At the 1981 Water Board hearings, the Dene Nation suggested that:

> "The NWT Water Board ought to require that the research, studies, contingency plan and recommended procedures or procedural modifications be submitted to the NWT Water Board as part of the water registry prior to the hearing of the applications for the licenses which are the subject of this hearing."

In other words, it was suggested that a minimum amount of research be done prior to the Water Board even agreeing to consider license applications. New areas such as recovery of oil under ice and in ice-infested waters were essentially uncharted at the time of the applications. There was also no documentation of patterns and land/water use by migratory birds in spring and fall, or possible effects of oil spills on them.

The Water Board did not see fit to take this suggestion. It granted the licenses, making the eventual submissions of such studies and plans a condition of those licenses. However, no schedule for reporting on this research was laid out and there was no mechanism for follow-up identified. Another baseline opportunity had been lost.

It should be noted that the monitoring being done now, to at least establish a baseline prior to the next project, is being done largely by 'weak' agencies, such as DOE and DFO, and at least in part in response to community concerns. Neither of the major regulators, DIAND and the NEB, has been responsive to such concerns or cooperative in addressing them.

Failure of EA's to Predict the Full Range of Impacts

The whole art of environmental impact assessment and prediction is scarcely 15 years old; it is very difficult to do accurately even under the best of circumstances (Staples, 1985). The main lesson that can be drawn from the failures in the impact prediction processes related to the Norman Wells Project is that "experts" and "science" cannot go it alone. As it turns out, local, "non-expert" people raised several concerns, at the pre-approval stage and during construction, that were not included in the formal EIA's or reports on hearings. Subsequently, there was resistance among the "experts", with some notable exceptions, to taking such concerns seriously. That resistance is beginning to break down now, five years after the hearings and after oil has begun to flow south.

The key impacts not accurately predicted during the formal environmental assessment processes are discussed below.

Release of Hydrocarbons by Trenching and Dredging

It was not foreseen that hydrocarbons could be released from the Mackenzie River bed during the activities surrounding artificial island construction and laying of the underwater pipeline gathering system at Normal Wells. There are well known "natural seeps" of oil from the riverbed but it is generally accepted that these have been accelerated by the trenching and dredging which began in 1982.

Such occurrences are possibly linked to problems with the health of fish downstream, problems that were noted by fishermen starting in 1983. Oil slicks apparently caused by dredging were first noticed on the river in 1983. None of these links has been firmly established, but the lack of baseline data on hydrocarbon levels in the river and the failure to predict such a possible impact made the task of studying the situations now more difficult. There is also the possibility that the water injection work begun by Esso at the beginning of the Project in order to increase their recovery rates from wells on both the natural and artificial islands may have increased the pressure in the underriver reservoir. This could possibly accelerate the natural seepage rates as well. Esso denies that the reservoir is connected to the areas which seep, but all agencies agree that there is very little really known, that it was not included in any of the EIA's, and that testing in order to discover more about it is not required by any of the licenses or permits.

Contamination of Fish

It is still not at all clear whether problems with fish downstream of Norman Wells (Fort Good Hope and Arctic Red River) are connected to the oil-field expansion, or whether in fact the range of problems is limited to the downstream area. Work is just now getting under way to study the problems, a difficult task given the lack of baseline data already mentioned.

DFO was vocal in raising fisheries concerns at the EARP and Water Board hearings (as already noted, they were denied intervenor status at the NEB hearings). However, these concerns were focussed on construction impacts at Norman Wells and at the pipeline stream crossings. Neither DFO, the proponents, nor the regulatory agencies formally foresaw the possibility of fish being contaminated by hydrocarbons, or of any other downstream impacts. The non-regulatory inter-departmental Research and Monitoring Group, set up in September, 1982, failed to identify fisheries and related water quality concerns as long term priorities. (This was changed in 1984 largely as a result of lobbying by the Dene).

Since 1983, the occurrence of fish with black, stunted livers, internal tumours, blood spotted eggs, small size and soft watery flesh has been documented by two communities: the Dene Nation and DFO. DFO has generally been cooperative, agrees that such problems were not anticipated, and acknowledges that government was not equipped to respond quickly to them once they were raised (e.g., two year time lapse between recognition of the concern and approval of funds from DFO and Northern Oil and Gas for an in-depth study.

Inadequacy of Responses to Unanticipated Impacts

The key point about unanticipated impacts is that they were identified by local people, not by inspectors from government and industry. And further, that the Dene, either through Community Councils or the Dene Nation organization, had to do their own research and lobbying in order to convince the monitoring agencies that the concern was real and a response required. This applied to both regulatory and non-regulatory agencies.

Release of Hydrocarbons by Trenching and Dredging

This concern was raised with both regulatory and non-regulatory agencies, first by the Community Council of Fort Good Hope, the community immediately downstream, and then by the Dene Nation as well. It took a year to convince most of the agencies that it was a concern. DFO was the exception. They were the first to formally raise the concerns. In a letter to Esso, the noted that "These (trenching and dredging) activities and especially the way they were rushed through the permitting process, are causing serious concerns for the Department of Fisheries and Oceans" (March 3, 1983). By the spring of 1984 (i.e., well into the last construction season and with the artificial islands nearly complete) both the Water Board and the Environmental Protection Service (EPS) were concerned. EPS maintained that no firm links had yet been established between the trenching/dredging and the unanticipated impacts but that no work had been done in the area. They suggested government monitoring start immediately as well as a requirement that Esso conduct their own sampling program. Such industry sampling is required for similar operations in the Beaufort Sea under Quarrying Permits issued by DIAND. EPS expressed surprise that similar requirements did not exist on the Norman Wells Project (pers. comm.).

The Water Board, which licenses Esso's use of water from the Mackenzie, also expressed concern. In a letter to Esso (June 18, 1984) the Board alerted them to the concerns being raised publicly. The letter admitted that monitoring of such concerns was not a condition of the license, but asked if there was a method by which Esso could voluntarily monitor and sample these oil slicks.

This was a weak request. It put the regulator on the defensive and it was not backed up by any enforcement powers. (Water licenses are inspected by DIAND inspectors, and, as shall be seen below, DIAND did not see this concern to be worth investigating).

The other factor preventing any serious study or resolution of this issue was that Esso and DIAND refused to accept that it was a serious cause for concern. The initial phone calls to Esso and DIAND staff at Norman Wells received the answer that the oil slicks were caused by the release of pockets of oil during the preparation of the riverbed for the laying of underground pipeline. They both felt that this just accelerated the natural release of oil and was therefore not a problem. Esso later said in writing (Minter to Warner, June 16, 1984) that "Dredging in the

Mackenzie River does not cause oil slicks in the river." It should be noted that DIAND is a major regulator of the project; it also owns one third of the oil at Norman Wells. It is possible that their vested interest in the project prevented a thorough investigation or even an admission that there might be a problem when such an unanticipated impact arose.

In spite of the concerns being raised by EPS, DFO and the Water Board, very little action has resulted. The DIAND Quarrying Permit was amended to require Esso to take core samples of dredge materials, but by this point, it was into the last couple of months of work. This only brought the sampling up to the level required elsewhere; it is not clear whether that level is adequate for a large northern river on which people depend for their livelihood. The results of this sampling only had to go to DIAND. The water license was not amended to require specific monitoring on an ongoing basis. The EPS-sponsored study on water quality, which did not include consultation and was responsive to community concerns, was delayed by funding problems. It only got under way in the summer of 1985, well after the trenching/dredging operations were finished.

The concern was raised again by the Dene Nation at the February, 1985 Water Board hearing into Esso's application to amend their licenses. The requested amendments were unrelated to this concern, but the point was made anyway that the questions about the effects of trenching/dredging were still unresolved. They had only "appeared" to "go away" because the work was finished. DFO's concerns are just now being addressed as the long-awaited Mackenzie River Fish Study gets under way (summer 1985).

The related possibility that the water injection process could be increasing pressure in the underriver reservoir and accelerating the natural seepage of oil was met with a similar response. Esso maintained that the main reservoir and the oil-seeping riverbed are not connected (personal communication) and yet other experts have speculated on the possibility that flow rates of natural seeps are decreased as a result of production (E.V.S. Ltd., 1985). It is an unanswered question whether they could then increase as the reservoir was re-filled - this time with water instead of oil. It is also curious how the decrease in seepage is possible if the reservoir and the riverbed are not connected. None of the monitoring agencies has pushed Esso on this. Water injection, unlike riverbed trenching and dredging, will continue for the life of the project, as it is the main method of increasing the recovery rates from the underriver wells. This concern is not likely to go away.

Contamination of Fish

The response to this concern has, if anything, been even slower as far as the main regulatory agencies are concerned. The initial documentation of the problem was done by the Dene themselves in the summer of 1983. With Water Board support, DFO was persuaded by fall of 1983 to take some samples at Fort Good Hope. The first results came back in April 1984. They revealed slight off-tastes and some traces of oil. Results of later tests, according to DFO memoranda, showed abnormal livers (dark and with low fat levels) and the presence of a number of compounds which may be petroleum hydrocarbons.

During late 1983 and early 1984, the Dene Nation successfully lobbied for the establishment of the Norman Wells Joint Environmental Working Group (NWPJEWG). One of the primary issues to be addressed was the fish, given the lack of regulatory response to date. Similar pressure resulted in the non-regulatory Research & Monitoring Group identifying water quality and related problems such as fish as a priority.

But people were still catching unhealthy fish.

DFO was cooperative and responsive from the start, but it has taken a full two years to convince the major regulator (DIAND) of the seriousness of the concern and to obtain extraordinary funding to initiate Phase I of a full fledged study. This study began in April of 1985 and includes detailed sampling and collection of socio-economic and fish-related information from fishermen and community residents. It is being funded by DIAND through the NOGAP and by DFO. The bureaucratic and political delays in funding have been the most frustrating for the Dene and for DFO officials. It is also interesting to note that the DFO funding for this study was taken from a program to fund an environmental monitoring vessel in the Beaufort Sea. This study is still not going to solve the problem. It is only funded for one year. If it does establish that there is contamination and/or tainting of fish and identifies possible sources, that is only a first step. Ongoing monitoring and mitigation measures would need to be developed, funded and implemented. In addition, there is the more complicated question of compensation to harvestors for the damage to the resource.

Inadequacy of Responses to Environmental Concerns Due to Jurisdictional Disputes

There are several impacts on water and fish that were predicted in the pre-approval stages but were poorly addressed due to jurisdictional disputes. The common result of these situations has been that the "strong armed" regulatory agencies have managed to "convince" the weaker agencies to back down. These weaker agencies, such as DFO and the Water Board, have generally been the most responsive to Dene community concerns. Indirectly then, the major regulators, NEB, DIAND, and in one case, the Canadian Oil and Gas Lands Administration (COGLA), are perceived as unresponsive to local concerns. These agencies also have the top-heavy and least community-responsive structures and processes.

Stream Crossings

Concerns with the impacts on fish at both the major river crossings (Mackenzie and Great Bear) and the smaller stream crossings were raised by DFO and the Dene at various hearings. However, two disputes arose during construction.

The first was a result of IPL's request to build the largest crossing, under the Mackenzie, during the winter of 1984 instead of the summer of 1984, as had already been approved. They claimed it would save over $500,000. This was done by an application for an amendment to their water license and by a request for NEB approval. The NEB approved the change quickly. The Water Board called a meeting of their TAC. DFO, through their representative on that committee, refused to accept the change because of possible impacts on fish. Both DFO and NEB claimed superior jurisdiction and a full-blown dispute developed. The Federal Coordinator of the Project (DIAND) decided to "try and persuade DFO to be less instransigent" (InterGroup Ltd., 1984) and managed to persuade senior DFO officials, over the heads of their own local people, to accept the change. The compromise was that no construction would take place during the spawning period of the northern pike (May 1 - June 15). Given the lack of baseline data on fish movements, and the fact that no construction was originally to have been allowed during that time anyway, this provision is of questionable value.

The power play was clear and DFO lost. It is interesting to note that the NEB chose to ignore the Norman Wells Environmental Assessment Panel recommendation that IPL be required to consult with DFO regarding outstanding fisheries concerns, thus paving the way for them to win out over DFO in such a dispute. DFO, in spite of their legislative authority and responsibility for fish, did not have intervenor status in front of the NEB and had no formal recognized authority to influence decisions such as this.

The second situation involved the more general problems at stream crossings on the smaller rivers and creeks, some 20 of them. As already mentioned, the NEB flexed its jurisdictional muscles at the project approval stage by not requiring IPL to consult with DFO about fish concerns at stream crossings, let alone forcing them to comply with any possible DFO recommendations.

DFO did not consider IPL's plans for monitoring at the non-licensed stream crossings to be satisfactory (pers. comm.). Monitoring was essentially to be surveillance only and was to be limited to visual inspection with no documentation of short term or long term impacts on fish. DFO's original proposal to address such concerns themselves by in-depth monitoring was cut back due to budget constraints. The agency attempted to persuade IPL to voluntarily upgrade their monitoring but was unsuccessful. Comprehensive monitoring of impacts on aquatic resources took place at only 2 or 3 stream crossings on the entire 800 km route.

This did not erupt into a full blown dispute but was a constant source of frustration to DFO, especially considering that the major documented impacts of the construction of the only other northern pipeline, the Alyeska line, were on fish at river crossings (Wright, 1978).

Use of Wood Chips on Slopes

After the permitting was complete, IPL requested to be allowed to use wood chips to insulate ice-rich, thaw-sensitive slopes. This required approval from the NEB and an amendment to the Land Use Permit issued by DIAND. The use of wood chips in this way was untested and had not been included in the original application. The NEB approved the request promptly, with no information on the possible effects. Both DFO and the GNWT Department of Renewable Resources submitted to DIAND that the permit amendment should not be granted because of possible, untested dangers to fish and the drinking water supply to Norman Wells. DFO was especially adamant and referred to its legislative jurisdiction over fish during a heated exchange with the NEB (InterGroup Ltd., 1984).

The meetings held to discuss this were private and organized by the Federal Coordinator, so it is not clear whether any 'deals' were made. But the result was that IPL got their amendment after the GNWT and DFO withdrew their concerns.

This severely weakened DFO's practical jurisdiction over fish, and made it even clearer that DIAND and the NEB were running the regulatory show.

Subsurface Safety Valves

This dispute arose when Esso applied to drop the requirement for subsurface safety or 'downhole' valves on its 46 offshore wells on the artificial and natural islands in the river. They claimed that the valves were expensive, time-consuming, and that their regular servicing was risky. They were included in the original drilling permits issued by COGLA, because of the offshore nature of the wells. (COGLA's regulatory authority on the Project applied only to the actual drilling operations at Norman Wells.)

The Dene, through representatives from Fort Good Hope, appealed to the Water Board saying that the valves were needed for oil spill prevention and that Esso should be required to install them as originally approved. The Water Board advised COGLA by letter that Esso's water license had been issued on the basis of the valves being there for spill prevention. The TAC facilitated a meeting involving residents of Fort Good Hope, Esso and COGLA officials, which did not resolve the dispute. COGLA proceeded to reclassify the wells as "on-shore", being convinced of the permanence of the artificial islands, and granted Esso's request. This was done with no formal recognition of the Water Board's jurisdiction, or any recognition of the outstanding concerns with oil spill contingency planning and clean up capability.

Recommendations

The following recommendations are intended to ameliorate the present regulatory situation. It is the considered opinion of the authors that real progress in local involvement in all aspects of resource development is not possible under the present system. A meaningful role for the Dene is only likely to be possible through a negotiated aboriginal rights settlement.

Improvement of Predictive Capability of Project EIA's

(i) That local and particularly native knowledge and understanding of the environment be accepted as equal to that of the "experts". This should apply to research priorities, past impacts and predicted effects.

(ii) That long-term funding for collection of baseline data and ongoing impact monitoring be assured prior to project approval. And that local people, through their own governing institutions, be the decision-makers in such studies which should include documentation of local knowledge.

(iii) That related agencies such as DFO be assured of full intervenor status at every pre-approval process and adequate funding to address both baseline data and impact monitoring needs.

(iv) That impact prediction be recognized as a part of a cycle of monitoring, so that the results (i.e., the "lessons of Norman Wells") are fed back into the predictive process for the next project.

Improvement of Monitoring, Assessment and Surveillance as Proposed in EIA's

(i) That the Water Board be provided with adequate staff resources to conduct ongoing research and analysis on issues affecting NWT waters; and further that the Board take over enforcement of its licenses from INAC.

(ii) That long-term, cumulative monitoring become a funding priority, including funding from industry as part of their rate bases at the time of approval.

(iii) That DIAND, among others, undertake to ensure compliance with land use permits, and Water licenses, including prosecution and permit-cancellation when justified.

(iv) That the EARP process and/or other environmental assessment processes be given some kind of legislative base and authority to ensure inclusion of their recommendations in terms and conditions applied to projects.

(v) That the Dene be guaranteed a meaningful and funded role in project surveillance and monitoring, and that this include the raising of environmental standards where national standards are insufficient to protect Dene land.

(vi) That the knowledge of local people be recognized and included on an ongoing basis (i.e., during surveillance and monitoring, as well as assessment). This involves a change in attitude by many government officials as much as any legal change.

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APPENDIX: MAIN GOVERNMENT AGENCIES INVOLVED IN ENVIRONMENTAL MANAGEMENT OF THE NORMAN WELLS PROJECT

Agency	License/Permit, Etc.	Enforcement Responsibility
NWT Water Board	Licenses N3L30919 (Esso) N3L30094 (Esso) N3L61126-A (IPL) N3L61126-B (IPL)	INAC (Water Resources)
INAC (Water Resources)	Water Use Authorizations (terminated by 0-in-C Feb. 1984)	INAC (Water Resources)
INAC (Land Resources)	Land Use Permits N83P906 etc.	INAC (Land Resources)
INAC/GNWT	Environment Agreement	INAC (Environment and Conservation)
NEB	Certificate of Public Convenience and Necessity (OC-35)	NEB
GNWT (Local Government)	Approvals for land use on Commissioner's Land (BLT's)	GNWT (Local Government and Renewable Resources)
GNWT (Renewable Resources)	Legislative authority (Wildlife and Environmental Protection Ordinances)	GNWT (Renewable Resources)
COGLA	Drilling Permits (Esso)	COGLA
DFO	Legislative authority when applicable	DFO
DOE	Legislative authority when applicable	DOE

APPENDIX: MAIN GOVERNMENT AGENCIES INVOLVED IN ENVIRONMENTAL MANAGEMENT OF THE NORMAN WELLS PROJECT (Cont'd)

Group	Sponsoring Agency	Participants
PCO	INAC	INAC
CC	INAC	PCO(chair), Federal Government, Dene Nation, Metis Association, GNWT, CEIC, INAC, IIA
NWPJEWG	PCO	PCO(chair), Federal Government, GNWT, Dene Nation, Metis Assoc.
Research and Monitoring Group	DOE	DOE, GNWT, DFO, EMR, INAC
GNWT Co-ordinators Office	GNWT	GNWT
Community Advisory Committee (CAC)	PCO	PCO (Chair) and community representatives

GHANA'S KPONG DAM - CASE STUDY OF THE ENVIRONMENTAL IMPACT

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Introduction

Ghana has no known coal deposits. Small quantities of oil have recently been discovered offshore. Hence the principal energy assets for some time to come will be hydro-electric power. Ghana's industrial growth demanded that an additional source of hydro-electric power be found to meet the ever-increasing requirement. Table 1 summarizes the principal sources.

TABLE 1 SUMMARY OF PRINCIPAL HYDRO SOURCES

Volta River	Installed Capacity (MW)	Annual Energy (GWh)	Remarks
Akosombo	882	5625	Commissioned 1966
Kpong	160	940	Commissioned 1982
Bui	300	1175	Prelim. Studies
Oti	200	710	
Pwalugu	36	133	
Pra River			
4 plants	230	640	
Tano River			
4 plants	137	356	

The responsibility for planning, executing and managing hydro power projects in Ghana rests with the Volta River Authority (VRA). While Environmental Impact Assessment is not yet a legal requirement in Ghana, the VRA, from the experience of the Volta Project (1962-65) has come to regard this procedure as an essential and valuable element in planning projects which had great potential impact on the environment. The present paper evaluates their role in the Kpong Dam Project on the Volta River, some 25 km downstream of the Akosombo Dam. This multipurpose hydro-electric project provides water for hydro power, irrigation and domestic water supply purposes. It was constructed between 1977 and 1982 and was commissioned on 1st July 1982, forming a headpond having an area of about 9000 acres (2600 ha).

The studies and survey of the Kpong project involving the construction of a dam, powerhouse, spillway, and dykes began in 1974. The VRA through its Volta Lake Research and Development Project, Resettlement Division and Lakeside Health Unit, was assisted by scientists and consultants from local universities and research institutions. The main areas of study were: public health, fisheries and hydrobiology, weeds and socio-economic concerns of the people to be affected.

The main objectives of the studies were:

(i) To identify, predict, interpret and communicate information about impacts of the Kpong Project on the environment.

(ii) To provide a reference point and baseline against which environmental changes could be monitored.

Summary of Findings and Recommendations

Public Health

There was a high incidence of communicable diseases in the area particularly malaria, gastro-intestinal infections, onchocerciasis, and urinary schistosomiasis. Intestinal worm infections were common especially in children reflecting a low standard of public and personal hygiene.

Onchocerciasis

Prevalence rates (based on skin snips) in the adult population varied from village to village ranging from 4.6% to 68.8%, the overall prevalence rate being 30.9%. The worse affected villages were in the area to be inundated. No case of total blindness was detected but 10.9% had depigmentation of skin and 3.7% skin nodules due to the disease.

Schistosomiasis

The urinary form of the disease (S. haematobium) was found among 24.3% (1391) of children aged less than 15 years. Prevalence in 10 villages ranged from

7% to 56.8%, with an average of 31.9%. The worse infected villages were in the areas where resettlements were likely to be. No cases of intestinal schistosomiasis (S. mansoni) were detected although the intermediate host Biomphalaria pfeiferi was known to be present in the area.

Recommendations for communicable disease control, particularly schistosomiasis included:

(i) continuous surveillance;

(ii) health education and mass chemotherapy, especially of migrants to the resettlement area;

(iii) location of resettlement villages at least 1 km from headpond and provision of adequate and dependable pipeborne water and latrines;

(iv) regular weed and aquatic snail inspection and control in the new lake;

(v) recreational facilities for children (particularly a swimming pool) were to receive serious consideration to reduce the temptation of swimming in the new lake; and

(vi) a special health unit to be set up to plan and implement a communicable disease control programme on a continuous basis in the area.

Fisheries and Hydrobiology

Studies of the physico-chemistry in the aquatic system and the biota were undertaken as it was expected that the project impact would be considerable.

Water Quality

The water discharged upstream from the Akosombo Dam was clear and contained very little suspended matter. Total dissolved salts measured between 52.2 and 61.6 mg/litre indicating poor plant nutrient content to support fast plant growth and development. The oxygen content, low near the Akosombo Dam picked up as the water moved downstream reaching percent saturation values of between 49 and 97.

The river prawn (Macrobrachium vollenhoven) present in the water was found by laboratory tests to be completely fresh water and omnivorous and could survive lacustrine conditions with sufficient oxygen and food.

Of the 110 fish species identified in the Volta Lake only 41 were recorded in the area of study, 6 new species were also identified. Of the 10 major economic (food) fish found the catfish chrysichthys and tilapia were the best presented.

To save the prawns whose natural habitats would most probably be modified or destroyed, rescue operations were recommended before the closure of the Dam. This involved building a fish culture station at Akosombo which could also be used for fish biology studies.

A rescue operation of the already depleted prawn population by the Volta Dam to a suitable river was suggested.

Aquatic Weeds

Weeds received intensive study as in the tropics their presence could interfere with proper management and fuller utilization of the impounded body of water, such as hydropower generation, fishery, transportation, potable water supply, recreational use, and more importantly their association with the snail vector of schistosomiasis. In the area of study were recorded 5 species of floating weeds, 2 species of submerged weeds, and 23 species of emergent or marginal weeds.

The weeds recorded in the area of study included all the noxious plants already known in the Volta Lake including the floating species (e.g., Pistia), submerged plants (e.g., Ceratophyllum), semi-aquatic vegetation (e.g., Typha and Echinochloa) and "sudd" vegetation. Weed infestation was also known to be related to annual rainfall regime and relative influx of nutrients.

At the time of study, it was known that the Kpong Dam would create a headpond covering 9000 acres of land, with a maximum depth of 15 metres near the dam reducing to an average over the entire area of about 5 metres and having a shallow shoreline and providing ideal conditions for weed growth.

The needs for an intensive weed management programme were emphasized as part of the overall project.

Socio-Economic Studies

The population of people in the area to be flooded (about 9000 acres) was about 7000, consisting of 5 ethnic groups: Ewe - 77%, Dangbe - 20%, and the rest were Akan, Hausa and Ga. They lived in some 68 villages of 2317 poor quality houses and hamlets. Village populations range from 5 to 500. It was a settled population with 50% below the age of 15 years. The population was 48.8% male and 51.2% female. Over 80% of the population were self-employed and were engaged in farming and fishing as primary occupations and petty trading as a secondary occupation.

A common characteristic of the riverside village was its remoteness, lack of health and sanitation amenities, non-existent or difficult road transport and very few primary schools, with enrolment of only 30% of children of school going age. With the exception of Kpong, the only big town in the area, all the villages depended on the river, streams and ponds for their water requirements.

Recommendations for the resettlement included:

(i) A resettlement based on the 5 ethnic tribal affiliations with carefully planned guidelines and a sixth resettlement for the semi-urban population from the lower Kpong which would be flooded.

(ii) Siting and location of the resettlement villages far away from the headpond with access to the water at definitive points.

(iii) Replacement houses to be designed to accommodate social and cultural needs.

(iv) Due regard to be given to establishing an economic base in the new environment by the provision of prepared agricultural plots and fishing gear to promote the fishing industry.

(v) Care to be taken that the resettlement areas were not insanitary and that the communities in the new villages were not unduly exposed to debilitating diseases such as schistosomiasis and intestinal helminthiasis.

(vi) Good roads for transportation and marketing of crops, possibly a road link over the dam between the east and west resettlements.

Impact Management

From the experience of the Volta project steps were taken to ensure that the Kpong hydro project would not adversely affect those people of the community directly affected. Thus the main hydro power construction works and the resettlement programme were regarded as components of a single indivisible programme and the consultants for the main project also had to provide consulting services for the resettlement project.

The welfare of the affected population was made a condition of the effectiveness of the total loans for the project. Thus the lending agencies funding the whole of the civil works, agreed to include some key elements of the resettlement programme in the main contract for the dam and powerhouse.

Sufficient time was allowed for a detailed programme of the whole project to ensure adequate consultations with all sections of the project including the people to be affected regarding their proper care based on the environmental impact reports.

Resettlement lands and social requirements took the same time priority as construction of the dam recognizing the difficulties adhering to tight schedules where resettlement is concerned.

Responsibility for the resettlement programme was that of the VRA with a Resettlement Officer in charge of operations.

The Resettlement Programme

The most important social impact of the project was the resettlement of 7000 people, mostly farmers, located in the future headpond area. Guided by clearly defined principles with the experience of the Akosombo scheme as hindsight, certain decisions were made and strictly followed.

The resettlement was based on ethnic tribal affiliations and the six villages were located so that there was the minimum amount of difficulty with respect to land and the host community.

The village size was such that it could support certain services, for example, a school, but not too large that the village environment and life-style were changed significantly.

Housing was equivalent to existing accommodation and designed to accommodate social and cultural needs.

Due regard was given to establishing an economic base in the environment by the provision of prepared agricultural plots.

Care was taken that the resettlement areas were not insanitary and the environment in the new villages was not unduly exposed to debilitating diseases such as schistosomiasis and intestinal helminthiasis.

Facilities provided for the resettlement villages included: primary schools, churches, roads, lanes, pipeborne water supply, electric power supply, market stalls and communal latrines.

The construction of the villages started in February 1977 and was completed in 1981 on time, as was the dam construction, thus allowing sufficient time for moving in.

The objective of the Kpong Agricultural Resettlement Programme was to provide sufficient land for the resettled communities to continue their traditional methods of cultivation and offer them the means for developing them by their own effort.

Emphasis was therefore placed on improved farming practices rather than on a large-scale mechanised oriented programme; for the farmers resisted mechanisation and the idea of co-operatives in favour of more traditional methods.

VRA was responsible for the development of land and its allocation programme. The Ministry of Agriculture became fully responsible for the post-resettlement phase, with emphasis on effective agricultural extension services. On the whole the programme has been successful.

Project Evaluation

Planning and Executing Stages

The Kpong resettlement programme was planned and executed as part of the main dam project and had the full backing of both the main civil contractors and the project consultants. Throughout the operations, there were periodic joint-review committee meetings which made it possible for modifications to be made where necessary. Thus, after the construction of the first few resettlement houses with landcrete a modification in the housing replacement policy was made and the houses in the five remaining resettlement villages were built with sandcrete which had been recommended and accepted as a better building material.

The formation of the Kpong reservoir did create a potential for the development of agriculture. Irrigation outlets were therefore provided within the dykes of the Kpong project earth-filling structures. The Kpong irrigation project for the resettlement villages was suspended to allow more time for study as it was felt such a scheme would increase the problem of bilharzia, especially when the proper management of the irrigation system was beyond the capability of the rural farming community without continuous technical assistance.

The proposed fish ponds for some of the resettlement villages were also not pursued for the same reason. It has been said that in the tropics a mismanaged irrigation system is more of a curse than a blessing.

Follow-up/Audit Results

With the completion of the dam construction in 1981, the six resettlement villages were ready for people to move into dwellings in which they would feel satisfied with the choice of their immediate neighbours and could accept the challenge of making a success of beginning new homes with the facilities provided by the VRA.

One of the problems which the VRA had to face during the early months of the resettlement in spite of careful preparation was the effect of socio-cultural impact on some of the people. To them they had lost all that was familiar and dear to them, including houses, burial grounds, shrines. This led to a feeling of depression, inadequacy and insecurity, which was particularly common among the elderly.

An important aim of the resettlement policy was for the resettlement villages to be absorbed into the normal hierarchy of towns and villages in the country as a whole.

On the contrary, the villagers continued to recognize themselves as belonging to VRA including all services, houses and farms. In general, VRA is held responsible for the efficient running and maintenance of the services. The responsible Local Authority was reluctant to take over the administration of the villages as was originally planned and agreed upon. The reason was mainly financial.

The resettlement villages have better services including electric power supply and pipeborne water supply which were lacking in the neighbouring villages belonging to the Local Authority which relies mainly on levies and taxes collected and could not spend a greater part of its revenue to maintain services it could not itself provide. Hence the settlers continue to look up to the VRA for the upkeep of these services.

The Kpong project planners were fully aware of the potential consequences of the decision to provide better facilities but they had to yield to external pressures and constraints coming from affected people, government officials and politicians.

Fishing Industry

The formation of the Kpong reservoir did help the development of the fishing industry. The estimated yield is 300 t/yr. As predicted, the common catches were Tilapia zillii, Hemichromus fasciatus and the catfish, chrysichthys.

The Clam populations on the other hand have drastically reduced by more than 50% within a year and it is feared that the end of the Clam industry in the area is in sight. Attempts are being made to plant the Clams in River Pra several miles away which has been found to have the characteristics which will most probably support the establishment of the Clam populations. As an economic resource, Clams provide protein and raw material (the shells) for the Iron and Steel, Ceramics, Glass, Poultry feed and Paint industries in Ghana.

Prawns were also adversely affected by the formation of the reservoir which was found to be poorly oxygenated at the initial stages. This was anticipated and rescue operations were mounted to save the prawns before the closure of the Kpong dam. They were transferred into fish ponds. In this exercise other institutions collaborated - Institute of Aquatic Biology, the Volta Lake Research and Development Programme, the Fisheries Department, the Volta Basin Research Project of the University of Ghana and the Kpong Project.

Public Health

An important aspect of the resettlement programme was public health. The health problems fell into two categories: health problems associated with poor environmental sanitation; and those associated with the creation of the headpond itself, namely Onchocerciasis (river blindness), Urinary Schistosomiasis (bilharzia) and Malaria.

The Health and Safety Department of the VRA is responsible for public health in the resettlement villages.

With the improvement of general environmental sanitation in the resettlement villages and personal hygiene, such diseases as intestinal helminthiasis were considerably reduced.

Onchocerciasis

It was recognized from the beginning that the formation of the headpond would help eradicate Onchocerciasis which was endemic in the area by the drowning of the rapids in the area. The infection is caused by the parasite

"Onchocerca volvulus" and transmitted by the bite of the blackfly - sinulium damnosum which breeds in rapids and fast moving streams.

The prevalence of the disease before the impoundment was about 40%. After impoundment the problem has been effectively eliminated.

Malaria

Malaria has been hyper-endemic in the area. The disease is transmitted by the bite of anopheles mosquitoes which breed in open water. There has been no change in the incidence of the disease before and after the impoundment.

Urinary Schistosomiasis (bilharzia)

Bilharzia is a snail-borne infection which might be expected in any water resource development scheme in the tropics. The Kpong hydroelectric project is no exception with the creation of a shallow headpond and the movement of some 7000 people to villages close to it, engaged in farming, fishing and possibly irrigation in the future.

The general bilharzia control measures in the resettlement villages included siting of the villages at least 1 km from the water, provision of pipeborne water supplied from the headpond to minimize water contact as much as possible, provision of acceptable latrines for all the villages to discourage pollution of the water, provision of each village with a point of entry into the headpond consisting of a boat landing with deep water to discourage wading and the institution of a regular snail and weed control at the boat landing stations.

Post-impoundment bilharzia control measures regularly carried out since 1983 by the Lakeside Health Unit, part of the Health and Safety Department of the VRA, include surveillance, treatment of bilharzia patients in all the resettlement villages backed by an active health education campaign aimed at mobilizing the people to participate in the control programme on a self-help basis. This community health programme has been popular and receives support in funds and supplies from VRA and the Valco Trust Fund - a benevolent trust set up by the Volta Aluminium Company of Ghana.

Between March, 1982 to December, 1984 post-impoundment epidemiological surveys of 5 resettlement villages for bilharzia infection were carried out on people of both sexes above the age of 6 years resident at the villages at the time of the surveys.

Of 3636 people registered for screening, 3176 were available for examination; 1120 (35.5%) were found to be infected and were treated with metrifonate tablets. There was a 100% cure rate.

The aim is to screen and treat as many of the resettled population as possible and to maintain periodic surveillance to detect re-infection.

Though the prevalence of the disease has reduced as a result of the post-impoundment bilharzia control programme, there is evidence that the transmission of the disease has not stopped. The boat landing sites provided for each village are not being used by the fishermen. The receding shores due to the long drought have rendered them useless. Fishermen and children still have frequent water contact to fish or to swim. Some people are still reluctant to present themselves for examination and treatment in spite of intensive health education. To reach the villagers the medical control team has had to camp in the villages and work till nightfall for a number of days on several occasions.

The lesson is once again learnt that human behaviour should never be taken for granted in any bilharzia control programme.

Aquatic Weeds/Snail Control

The surveys conducted along the shoreline of the headpond one year after the impoundment showed that thick growths of weeds particularly Phragmites, Commelina, Cycleserus, Vossia and Eichinochloa pyramidalis had already established themselves in various parts of the water. Sudd formation had also started.

On the other hand snail populations particularly Bulinus truncatus found in the shoreline with the weeds was very low; very few of these were infected. In March 1984 from the 8 sampling locations 9 out of the 222 snails collected were infected.

The long drought of 1983/84 and the water recession could have played a part in the low snail populations found. A sample survey in March 1985 did not show significant change in the snail population and the infection rate was found to be 11/107 (10.2%). Special watch is being kept on the presence of the vector snail of Schistoma mansoni Biomphalaria pfeifferi.

It has proved difficult to control the snail vector by eliminating the aquatic weeds. The effective herbicides are not being used because of their side-effect of contaminating drawdown soil and inhibiting the growth of some crops. Mechanized clearing requires continuous labour to be successful and is impracticable because of the large areas involved. The involvement of the villagers in the control programme on a voluntary self-help basis has been poor. An incentive scheme has been suggested as a possible solution to this problem.

The post-impoundment survey has given ample evidence of the importance of regular monitoring and surveillance, adequate institutional support and active community participation.

Considerations on Organization of Bilharzia Control Programme as part of Primary Health Care

(1) It was soon realized that it was not enough to deliver health care to the people receiving it, rather they should be activated and organized so as to be able to participate in the bilharzia control programme.

The role and function of health personnel in rural health care programmes particularly the bilharzia control programme need considering carefully, for their traditional training does not seem to prepare them for rural community health care programmes where they would have to assume the role of leader and manager of the health team and also of the resources of the community.

(2) It is becoming increasingly clear that an efficient and economical bilharzia control programme particularly in the rural areas is feasible only when integrated with the health care programme of the community as part of community development planned to suit the prevailing social and economic conditions and the availability of resources in personnel, facilities and finance.

Such an organization can be the basis of a multi-purpose and multi-sectoral health programme which integrates all such services as health education and social welfare. For example, the aquatic weeds and the associated snail vector of bilharzia should be emphasized in biology classes in all schools in the community to enable all school children to participate effectively in the control programme.

Conclusions

The Kpong multi-purpose hydro-electric project provides water for hydro-power irrigation and domestic water supply purposes.

Studies of the environmental impact of the Kpong Dam were considered an essential and valuable element of the project development.

The usefulness of the environmental impact statement and analysis is demonstrated particularly in identifying, predicting, interpreting and communicating information about the impacts of the project.

The positive contributions of the project are highlighted, while the mitigation of unavoidable adverse effects by careful planning, explicit management strategies and sustained community efforts is seen as a necessary condition to achieve the project objectives, and at the same time satisfy the legitimate socio-economic and health requirements of the affected people in the area including the well-being of the ecosystem on which their survival depends.

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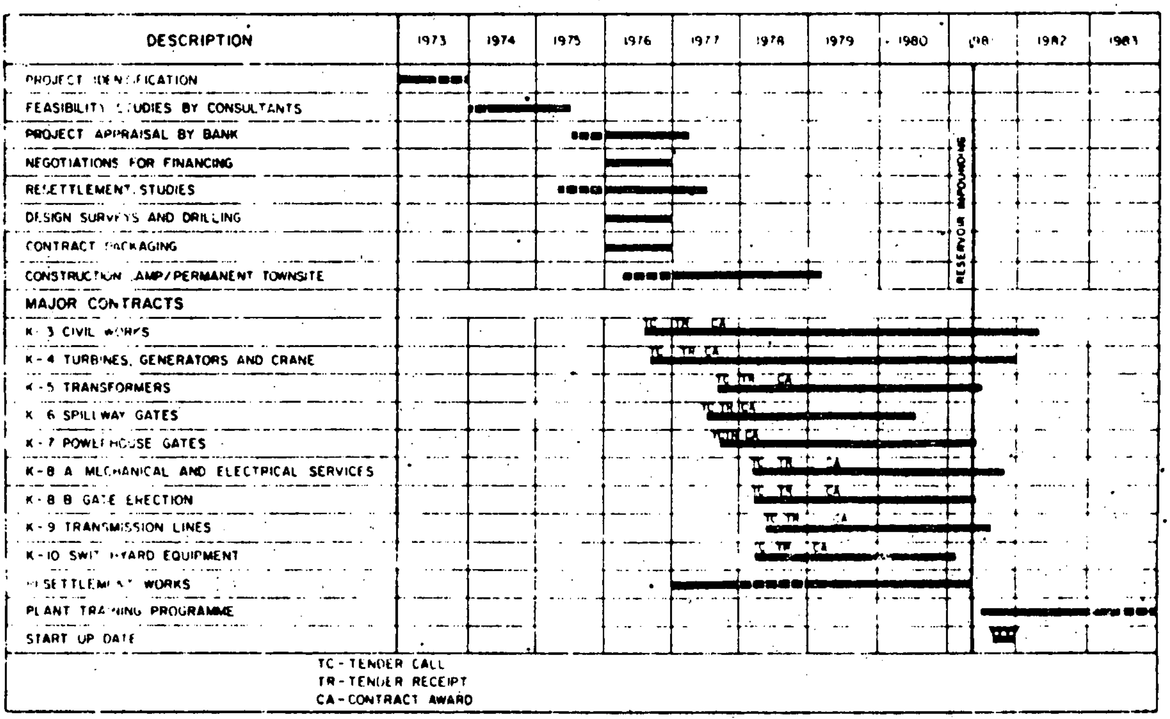
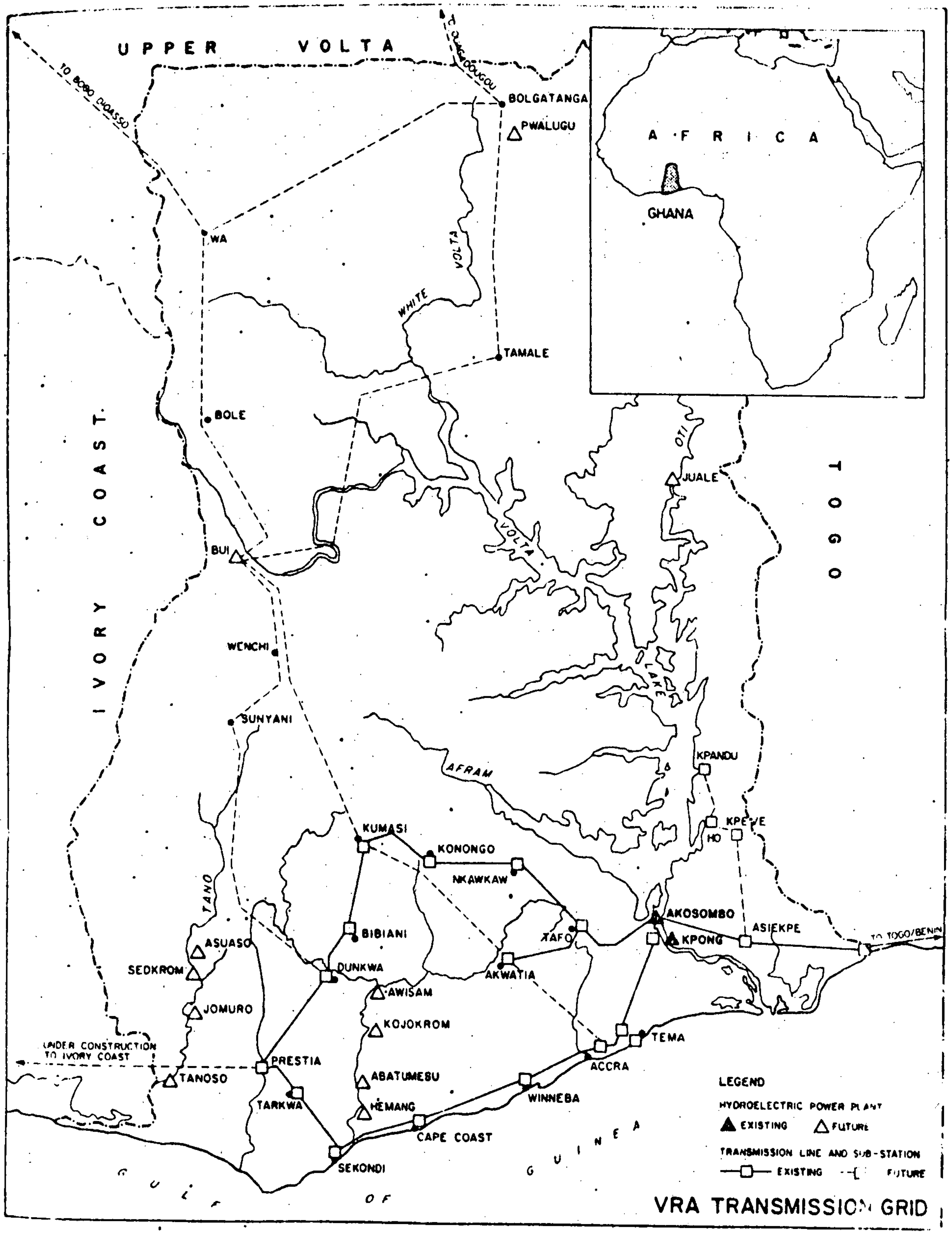
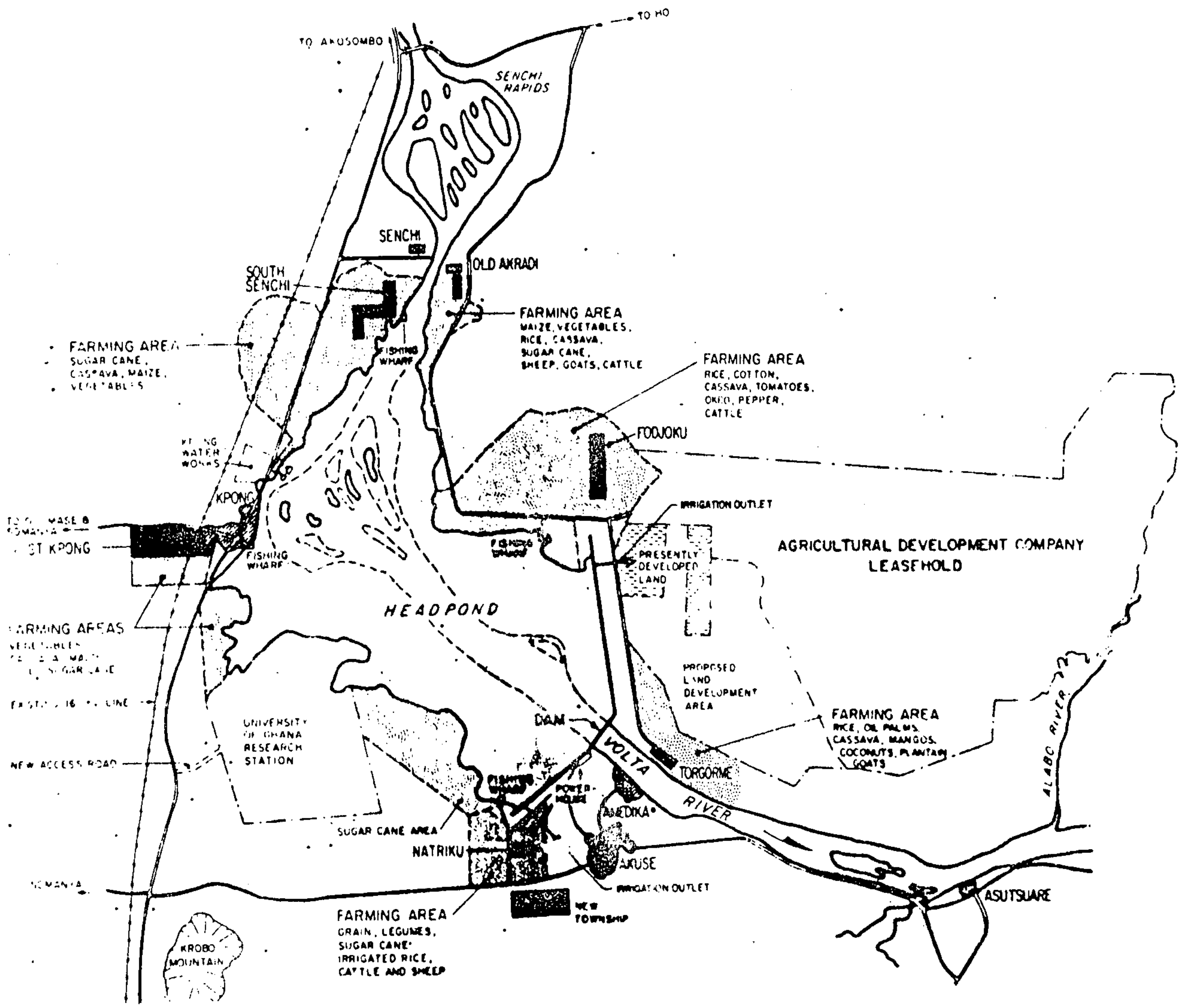


PROGRAMME FOR IMPLEMENTATION OF THE KPONG HYDRO-ELECTRIC PROJECT



MAP 1 MAP OF GHANA SHOWING VRA TRANSMISSION GRID



MAP 2 KPONG PROJECT RESETTLEMENT REGIONAL MAP FINAL ARRANGEMENT

ENVIRONMENTAL ASSESSMENT AUDITS IN THE U.K.: SCOPE, RESULTS AND LESSONS FOR FUTURE PRACTICE

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Introduction

Initially certain definitions of environmental assessment audits are presented and a brief consideration is made of the relationship between audits and monitoring. Approaches adopted, and results arising, from recent auditing studies in the U.K. are then presented. The paper concludes with a discussion of the conceptual and practical difficulties encountered in undertaking audits, and the potentially important role they could play in improving environmental assessment systems generally.

Environmental Assessment Audits: Definitions

When considering the role of audits in improving EIA systems there are several activities which come under such a title. Four types of audits are defined and it is suggested that two categories, the audit of project impacts and the auditing of impact predictions have the greatest potential for improving EIA (U.N.E.C.E., 19).

Implementation Audit

This is an activity undertaken by a regulatory agency which seeks to ensure that the plant and machinery which has been authorized are installed satisfactorily and operate correctly. Implementation audits essentially "police" projects to ensure that any mitigating measures recommended in the EIAs, for example pollution control equipment, are installed and that agreed levels of pollutants, for example concentrations of oil in water bodies, are not exceeded. Enforcement of mitigating actions placed on developments is a key activity if the utility of an EIA is not to be undermined. Implementation audits do, however, contribute little information feedback to improve future EIAs. In essence they are reactive actions. Implementation audits may be enforced by a legal process which makes certain activities, such as the illicit dumping of toxic materials, an offence.

Performance Audit

This is a management activity which examines the response of personnel concerned with the project operation to possible environmental problems which might occur. Performance audits may be undertaken by regulatory authorities but normally are conducted by project managers. Essentially, they are concerned with reviewing whether the actions that would be required to deal with a major environmental incident are satisfactory. The speed and nature of the response to a malfunction, such as discharge of toxic materials or an explosion, may prove decisive in minimizing the potential harmful effects.

Project Impact Audit

This activity is designed to identify environmental changes that have occurred as a consequence of a development. It examines the changed state of the environment and potentially has a greater feedback role than the two audit activities already described. The study of actual impacts provides detailed environmental information which, in appropriate circumstances, may provide a valuable basis from which to undertaken EIAs on similar projects. It has an important role in improving the art of impact identification, thus ensuring that future EIAs comprehensively analyze all relevant topics of environmental concern. Auditing of actual project impacts can also indicate where environmental knowledge may be limited. In these circumstances, it could be a stimulus for further research which may provide data for better environmental management practices in the future.

Auditing of Impact Predictions

This type of audit provides the most effective feedback mechanism for improving current EIAs as it specifically tries to assess the performance of EIA methods (for example, matrices, networks and scaling-weighting checklists) and predictive techniques (for example, air pollution dispersion models). The main objective is to compare the actual environmental impacts of a project by the use of monitoring data with those which were predicted before the project became operational. In this way, it is possible to determine whether past EIAs have adequately considered all the significant environmental impacts which were predicted. Essentially, it is concerned with whether the impact identification process has performed satisfactorily. It is also possible to assess the ability of EIA methods and techniques to accurately predict the consequences of a development. The auditing of impact preconditions may also indicate areas of information deficiency or where monitoring schemes fail to provide the information for which they were designed.

As well as these four major types of audits, a number of other ones have been defined and these are included in Table 1. For the purpose of this paper, however, the U.K. studies focus on performance audits and the auditing of impact predictions.

TABLE 1 SUMMARY OF DEFINITIONS OF AUDITS

1. Implementation audit - determination as to whether EIS recommendations were implemented.
2. Performance audit - review of internal environmental management of a project within a company and its ability to respond to incidents.
3. Project impact audit - examination of the impacts arising from a project once operational.
4. Impact prediction audit - comparison of actual project effects with the predicted consequences to verify or improve predictive techniques.
5. A draft EIS audit - evaluation of the draft EIS against its terms of reference.
6. Decision point audit - examination of the effectiveness of the EIS as a decision-making tool.
7. EIA procedures audit - examination of the performance of EIA procedures at the macro level.

Monitoring and Auditing

Auditing of impact predictions and actual project impacts requires results from monitoring schemes. There are many types of monitoring programs currently undertaken. While they have different objectives, all can be of relevance to EIA but not of equal importance in their potential utility.

Monitoring programs can be divided into two main types. First, there is the monitoring of targets, usually organisms, which may undergo change as a result of an externally induced agent, such as a new project. The monitoring of targets can occur at various points in a notional hierarchy of organization. A second type of monitoring can be termed factor monitoring. This is concerned mainly with measuring the levels of particular parameters (usually chemicals) which may cause environmental changes. Both types of monitoring are of use at various stages in EIA. A main component in EIA studies is the gathering of baseline data. These data are used to build up a picture of existing environmental conditions, and processes of change (trends). It is essential that environmental trends be established and that the nature of the environment likely to be affected by a proposal be projected in the same time scale as the impact predictions for a proposed project (for example 10, 20 or 50 years hence). This is necessary because it is important in EIA to compare the state of the environment when affected by a project with its condition should the project not proceed. Only then can a valid comparison between the project and no-project alternative be made. In EIA it is essential to have information on "moving" baselines incorporating the processes causing environmental changes.

Baseline data are of great benefit in aiding identification of project impacts and in helping to determine their nature, extent and likelihood. Its utility in audits lies in the potential of baseline monitoring to be continued throughout project construction and operation (at sites thought to be unaffected by the project, known as "reference" or "control" stations) and to provide data which can be used as comparisons with data from similar sites known to be affected. This allows changes in environmental parameters, at affected sites, to be assigned to a project and not to other external influences.

The most important type of monitoring for EIA purposes is impact monitoring. This involves determination of the actual impacts of operational projects and, when possible, testing the accuracy of predictions made during EIA work. This type of monitoring involves target monitoring, and, in the case of environmental impacts on species populations and ecosystems, structure and function is very difficult to implement.

Performance Audits: The Example of a U.K. Oil Major

British Petroleum (B.P.) undertake environmental audits or environmental reviews, which are essentially performance audits, as standard company policy. This section of the paper will consider the nature and objectives of the audits as seen by the developer (Scupholme, 1984).

Environmental audits are essentially "snapshots" taken during the construction and operational phases of a project. Their aim is to establish whether the environmental standards laid down in the original assessment, or subsequently, need to be revised. By this means, the adequacy of protective measures and management procedures can be assessed.

Recent audits have taken place on the Forties field, at Rotterdam and Grangemouth refineries and a number of distribution terminals. In those few cases where the need for remedial action has been identified, it has been on an encouragingly minor scale (British Petroleum, 1983).

As stated in the above Company Policy, it is intended that the process of environmental assessment should continue throughout the life of the scheme. Environmental monitoring programs are carried out to ensure that statutory discharge consents are met and that the quality of the local environment is not significantly affected. This monitoring can include benthic surveys in the case of seabed biological studies, chemical analysis of effluents, and measurements of atmospheric pollutants and noise levels. The frequency of monitoring depends on the nature of the impact under investigation and on legal requirements. However, it is not uncommon for there to be operational changes during the life of an oil field. New facilities may be added, others shut down, and legislative controls may change in response to either a better understanding of environmental conditions or in response to public demand.

Notwithstanding these changes it is easy to become complacent and to assume that because an EIA has been produced for the project all subsequent operations will be environmentally acceptable. Furthermore, new management may become responsible for the operation who are not familiar with the results of the EIA. There is therefore a real need to continue the process of assessment throughout the operational life of the system.

Like the EIA, the environmental reviews are prepared for two audiences: firstly, internal operations management and secondly, external organizations. The presentation of an environmental review to an external audience is useful to ensure a continued and proper concern for the environment surrounding the operation, and also in support of planning applications for new projects and developments. The review is not therefore regarded as a confidential document and it is company policy to discuss the results of reviews with a wide range of interests: government, local authorities, conservation groups and other interested bodies.

The timing of the environmental reviews depends on the nature of the operation. However, it is B.P. policy that they should be carried out every three years unless operational conditions require a different approach.

The principal aim of environmental reviews is to assess environmental performance in the light of current and anticipated legislation and to advise management on the effectiveness of environmental measures making recommendations for improvement where appropriate. The secondary aim is to comment on the effectiveness and value to management of the EIA carried out prior to the commencement of operations. This secondary objective is important and benefits future EIAs. There is no point in making detailed environmental predictions if they are not followed up and tested during subsequent operations. However, in practice it is difficult to achieve this aim because many early EIAs prepared by B.P. did not set out to make testable predictions.

To achieve the principal aim of the review, the following detailed <u>objectives</u> are agreed:

1) to assess environmental performance vis-à-vis legislative and company standards;
2) to highlight sensitive environmental issues surrounding the operation;
3) to comment on the possible influence of future legislation;
4) to review the results of environmental monitoring programs and to suggest changes;
5) to check EIA predictions; and
6) to prepare a report for internal and external audiences.

As in the case of EIAs, the company does not work to a recognized methodology for carrying out these environmental reviews. The review is normally carried out by a team of three or four people over a period of three to four months. The team makes site visits and has detailed discussions with management and operational staff at all levels. Access to records is made available and the team is encouraged to be as objective as possible. A representative of the operational staff would not normally sit on the review team but would be nominated as a point of contact with other operational staff.

The <u>contents</u> of a typical environmental review can be listed as follows:

- description of the facilities,
- summary of legislative and regulatory controls,
- assessment of compliance with controls,
- review of environmental monitoring programs,
- identification of critical activities with potentially largest environmental impacts,
- appraisal of management awareness of environmental responsibilities,
- assessment of public interest shown in the operation, including complaints, etc.,
- conclusions and recommendations for improvement where appropriate.

Post Development Audits to Test the Accuracy of Environmental Impact Predictions: A U.K. Case Study

Background and Study

This study was undertaken by Project Appraisal for Development Control (P.A.D.C.), now Centre for Environmental Management and Planning at Aberdeen University. The major objective was to compare predicted impacts with actual impacts for a number of selected development projects (P.A.D.C., 1983).

By determining the accuracy of impact predictions, the research aimed to identify the "best" predictive techniques and to suggest how improvements could be made to EIA practice.

In selecting the case studies, three criteria were adopted. For each one there was a need for:

(1) sufficient detailed data on pre-development environmental characteristics;
(2) comprehensive or partial environmental impact analyses; and
(3) sufficient data from monitoring schemes which could be made available.

These objectives were formulated when little experience of audits existed in the U.K. The Sullom Voe and Flotta case studies indicated that it was not possible to identify case studies suitable for auditing without actually undertaking an audit. This situation arose as it was impossible to establish from the collection of baseline and monitoring data, and information concerning the state of the environment, whether predictions could be audited. Only by implementing an audit could this be achieved. Considerable time was therefore spent, towards the end of Phase 1, attempting to audit these projects.

Results from pilot studies indicated that it could be very instructive to examine more projects to establish whether the preliminary findings from the Sullom Voe and Flotta case studies were of wider applicability. This occurred in Phase 2 which also lasted for one year.

Experience gained in the pilot studies led to a change in emphasis in the research objectives in Phase 2. The new objectives were:

(1) to identify impact predictions and test their accuracy;

(2) to identify and test techniques used to predict impacts; and

(3) to ascertain whether methods used in preparation of EISs identified all impacts known to have occurred.

In Phase 2, audits were undertaken for the Redcar steelworks and the Cow Green reservoir. The Sullom Voe and Flotta "pilot" audits were then re-examined in the light of these new objectives. A number of other case studies were also considered, but were rejected on the grounds that the preliminary findings in Phase 1 indicated that an intensive study would have greater utility than an extensive study.

Method for Implementing the Audits

The method for implementing the audits can be subdivided into the following activities:

(1) identification of environmental impact predictions,

(2) classification of predictions,

(3) identification of predictions capable of being audited; and

(4) information collection and analysis.

<u>Identification of environmental impact predictions</u>

At the outset it was necessary to determine the type of statements considered to be "environmental impact predictions". This involved defining the term "environment". One constraint was that the research brief restricted the study to the natural, physical environment. Consequently socio-economic impacts (including transport and health) were excluded. Predictions dealing with the visual aspects of a project were included.

Next "impact prediction" had to be defined. Initially, any predictive statement within the scope of the preceding paragraph was considered to be an impact prediction. However, many of the predictive statements identified were concerned with such features of the proposal as concentrations of compounds to be found in the effluent. While such statements were predictive, they did not describe an environmental change. It was considered that such statements could only be regarded as impact predictions if they went further and predicted ambient concentrations or effects of pollutants rather than only emission concentrations. Consequently, the following definition was adopted:

> "a probabilistic statement concerning a change or changes in environmental parameter or parameters arising from a project action" (Also, "no change")

Two other decisions were required before a working definition of "impact predictions" could be adopted. First, many EISs contain statements concerning the impacts that may arise from implementing mitigation measures. Such statements were not included in the audit as evidence indicated that there would be little monitoring data or information available to formulate judgements as to the accuracy of these predictions.

The second decision concerned the interpretation of statements made in EISs. Often EISs contained statements which describe or discuss experience of the environmental impacts of similar projects at comparable sites. However, many such statements fall short of predicting that the proposed project will have similar consequences. Such statements were termed "implied" predictions and were excluded from the case study audits because of the lack of direct reference to the project being assessed in the EIS.

<u>Classification of predictions</u>

The first classification was according to subject matter; for example, whether a prediction forecast oil spills or vegetation changes. A second classification was made according to the degree of probability expressed in the predictions. This was to ascertain whether statements containing expressions of high probability of an impact occurring were more accurate than those with lower inherent certainty. It was not possible to incorporate all predictions into this latter classification, since in some cases predictions were so worded that it was difficult to determine the nature of their "probability" content. Difficulties were also experienced with predictions which were expressed in a table, for example ambient

TABLE 2 CLASSIFICATION OF IMPACT PROBABILITIES

Expression in Prediction	
Will, would:	Certainty
Should, likely, unlikely:	High probability
Probability, reasonable to expect, anticipated to, felt to be:	Moderate probability
Could, might, perhaps:	Low probability

pollutant concentrations arising under different meteorological conditions, unless the accompanying text indicated the probability of the concentrations occurring.

Various expressions of probability were ranked according to the degree of certainty they implied using a dephi technique (see Table 2). It was decided that an attempt should be made to determine whether predictions expressing a high level of certainty were easier to audit more accurately than those expressing a lower level of certainty.

Identification of predictions capable of being audited

After identification and classification activities were completed, a decision was made as to whether predictions were presented in a form which would allow an audit to be performed. Did predictions contain factors which could be tested? It was considered that the more clearly a prediction was defined in terms of features such as probability of occurrence, area to be affected, time scale and intensity of impact, the easier would be the task of assessing its accuracy. In particular, the more a prediction resembled an hypothesis with defined boundaries of application, the easier it would be to refute or substantiate it. Unfortunately, impact predictions are often not expressed as hypotheses. Furthermore, many impacts are not readily quantifiable and are only described in qualitative terms. While it remains possible to audit such predictions, they must be expressed in precise terms. Imprecision or latitude of meaning makes auditing impossible. In all the case studies, examples of vague, imprecise and "woolly" predictions existed. For example, one EIS contained the following predictions "...a major oil spill would have potentially disastrous effects on fish spawning areas" and "...the likelihood of objectionable odours reaching local inhabitants is small". Such impacts were not included in the audit because of their degree of imprecision and were regarded as being untestable in the audit. Those predictions which remained were considered to be theoretically testable provided data or information were available to perform the audit. Similar findings on the wording of predictions in Canadian EISs are contained in Beanlands and Duinker (1982).

Information collection and analysis

During this stage information had to be collected in order to perform the audit. To assist in this process, a series of questions were formulated. Two types of questions were developed and can be illustrated by reference to oil spill predictions. The first type of question was designed to determine whether the preconditions or assumptions accompanying a prediction had been fulfilled; for example, had any oil spills occurred under the prescribed conditions. If it was found that the preconditions were satisfied then a second type of question was formulated to obtain information regarding the impact and to determine whether the prediction was accurate.

Responses to these two types of questions were generally obtained from local experts, who based their responses either on data from monitoring programs or on their interpretation of events. In the latter case, it was necessary to corroborate their judgements by seeking other views. Raw monitoring data were not used in the audits because of insufficient time available to perform the analyses required to interpret the data except in the Redcar audit where raw data on ambient pollution levels were analysed because so many predictions were concerned with air pollution that it would have been impossible to perform an audit without first analysing the monitoring data.

Results

Table 3 summarizes the results of the four case studies. As can be seen, there is a considerable difference in the number of impact predictions identified. The Flotta and Redcar projects were preceded by multi-volume EISs whereas the Sullom Voe project was assessed in a single report. The Cow Green reservoir was not subject to a formal EIA and predictions were obtained from a variety of sources, although most were obtained from two sets of transcripts of select committee hearings in both houses of Parliament. Comparing the scope of the

TABLE 3 RESULTS OF CASE STUDIES

	Sullom Voe	Flotta	Redcar	Cow Green
1. Number of Predictions	52	459	220	60
2. Prediction Probability				
(a) Certainty	17	68	37	48
(b) High Probability	24	18	18	2
(c) Medium Probability	11	2	8	10
(d) Low Probability	0	371	19	0
(e) No obvious probability	0	0	138	0
3. Number of Predictions not audited due to				
(a) Form of Presentation	11	5	3	0
(b) Project Design Change	0	6	160	18
(c) Lack of appropriate environmental conditions	6	395	0	6
(d) Lack of data on actual impacts	8	36	36	7
4. Number of Predictions Audited	27	17	21	29
5. No. of Predictions for which no conclusion on Accuracy/Inaccuracy Possible	0	5	10	2
6. Number of Accurate Predictions	18	7	5	14
7. Number of Inaccurate Predictions	9	5	6	13

EISs, it was noticed that those for Flotta and Redcar were more comprehensive than for Sullom Voe, thereby accounting for the larger number of predictions. Additionally, both EISs for Redcar and Flotta contained techniques for predicting noise/air pollution impacts and oil spill behaviour respectively. These techniques produced a large number of individual predictions concerning levels of various air pollutants at different locations (Redcar) and the behaviour of oil spills in a variety of environmental conditions (Flotta). After identification of predictions they were classified according to probability.

Results show that most predictions contained a form of words which expressed a high level of confidence that the expected impact would occur. The exception is the Flotta EIS which contained many predictions concerning oil spill incidents, most of which expressed a low level of probability. Although the Sullom Voe EIS is also concerned with oil spills, the attention devoted to them is significantly less and greater confidence is placed in the predictions being accurate in the eventuality of an oil spill incident. Redcar shows a large proportion of predictions which could not be classed in terms of probability. Many air pollutant predictions were contained in a tabular format from which it was not possible to deduce a probability classification. Also, the accompanying text did not provide a phrase which would enable a classification to be made.

In all the case studies, predictions were found which made auditing difficult, and sometimes, impossible. Impact predictions were often expressed in vague, imprecise and "woolly" language. Whenever possible, the predictions were interpreted subjectively to enable them to be audited. A number of assumptions about the meaning of predictions had to be made. However, some predictions remained which were considered to be untestable due to their wording and, therefore, could not be audited. Many predictions were testable, but could not be audited for other reasons.

The number of predictions rejected as being unsuitable for auditing due to form of presentation is given in Table 3 for each case study.

The next stage in the audit involved the identification of changes in the design of the project which might render certain predictions obsolete and irrelevant. For example, if a prediction is based upon a specific chimney height, effluent throughput or outfall pipe location any changes to these components prevent those predictions being audited. In the case of Redcar, a large number of predictions could not be audited since the predictive techniques used were based upon a design which was later modified.

The Sullom Voe terminal, unlike the other case studies, exhibits a low number of predictions which could not be audited due to project design changes. The reason, partly, lies in the relationship between the Sullom Voe EIS and project design. The EIS was prepared concurrent with project design and construction, and incorporated changes which were being made.

An additional process of elimination was necessary. In two of the case studies, Sullom Voe and Flotta, a number of predictions were contingent on certain assumptions concerning environmental conditions. For example, many oil spill predictions for the Flotta terminal were dependent on certain assumptions concerning wind speed, etc. Such predictions could not be audited if the requisite environmental conditions had not occurred. A number of further predictions could not be audited because there was no monitoring data or other information which allowed an assessment of accuracy to be undertaken.

It was found, on occasions, that monitoring was being undertaken for environmental parameters mentioned in predictions, but that it was not initiated to enable predictions to be audited. In the Redcar case study, for example, predictions were made concerning the air pollution impacts of the steelworks in isolation from other sources of pollution. Monitoring data were available concerning ambient pollutant concentrations, but the task of isolating the influence of the steelworks was impossible given the location of the monitoring stations and the type of data collected.

The major finding is the low number of predictions that could be audited for Flotta and Redcar being 3.7% and 9.5% respectively. Although the proportions for Sullom Voe and Cow Green are significantly greater at 52% and 48% respectively, the figures show a far from satisfactory state-of-affairs since the Sullom Voe and Cow Green projects have the most intensive and varied monitoring program of the four case studies examined. Both these projects also had the lowest number of predictions identified.

Auditing of predictions sometimes led to a situation in which it was impossible to come to a firm conclusion regarding the accuracy of predictions. This was due to the data/information only being indicative of accuracy.

One particular problem faced when assigning accuracy to a prediction deserves discussion. Many predictions do not contain any reference to the time period within which an impact might be expected. Therefore, monitoring data might show that an impact has not occurred, but the possibility remains that it might occur some time in the future. Such predictions were regarded as being accurate/inaccurate.

Table 3 shows the breakdown of audited impacts for all case studies, and the total number of accurate and inaccurate predictions. It also shows the number of inaccurate impacts which predicted an impact which did not occur and those which predicted no impact when an impact did, in fact, occur. Additionally, it shows the proportion of inaccurate impacts which over/underestimated the extent of actual impacts.

Conclusions

Overall, the audit research has shown that it was possible to identify predictions although this involved eliminating repetitious predictions. In many cases, the meaning of predictions was not clear and it was necessary to seek clarification, whenever possible, from those who had formulated the predictions. A small number of predictions could not be audited, since their meaning was so vague and imprecise that any conclusion reached on their accuracy would have been an unsubstantiated value judgement.

A number of other problems were identified which act against auditing. Many monitoring programs were not linked to the impacts identified as important in EISs. This made auditing of some impacts impossible. In addition, monitoring programs established to measure environmental parameters likely to be affected did not always provide data enabling cause-effect relationships to be determined between the project and measured environmental changes. Also, in the case of oil spill impact predictions, auditing was impossible unless the conditions specified in the predictions were met. Finally, some predictions were obsolete because design changes had been made to the projects after completion of the EISs.

Consequently, it has been possible to audit only 12% of all predictions. Of those audited, it was possible to come to a firm conclusion on accuracy for 82% of the predictions. In the Redcar, Flotta and Cow Green cases approximately 50% of the predictions were accurate. The Sullom Voe audit showed that 66% of the predictions were accurate. There was a tendency for inaccurate predictions to involve impacts which did not occur subsequently. This characterized all the case studies to varying extent. Although an attempt was made to determine the extent to which inaccurate predictions under- or over-estimated actual impacts, it is impossible to come to any firm conclusions. In the Flotta and Sullom Voe EISs, there were insufficient inaccurate impact predictions which could be classified. The results from the Redcar and Cow Green cases show opposite situations. In the Redcar case study, it was found that 5 predictions over-estimated actual impacts and 1 under-estimated the impact. However, the Sullom Voe case study reverses this finding (7 predictions under-estimating impacts and 2 predictions overestimating impacts). Finally, the results show that significant numbers of predictions containing expressions indicating a high level of confidence that impacts will occur turn out to be accurate.

Very few predictive techniques have been identified and it has been very difficult to test those utilized. Predictive techniques are only as good as their predictions. It was found that predictions audited were not based on use of a technique and that when a technique was identified (Redcar) it was not possible to audit the predictions. Therefore no conclusion can be drawn about the utility of specific techniques.

No explicit EIA method was used in any of the EISs. Therefore, research focused on whether the ad hoc approaches used were comprehensive and covered all impacts. It was found that a number of impacts occurred which were not included in EISs. Most of these impacts were "secondary" in that they were the result of activities associated with a project, but occurring at spatially distant locations (for example, aggregate extractions).

A few direct impacts, that is, impacts resulting from the development, were omitted from EISs. The individual factors involved in the impacts had been identified, but their possible relationships in the form of an impact were omitted. It seems that a formal, but simple EIA method, such as the two-dimensional interaction matrix consisting of a vertical list of environmental features and a horizontal list of development activities would have been an asset to the assessment process. Such a matrix aids the systematic identification of potential impacts by structuring thought to all possible linkages between development activities and environmental components.

The main conclusion of the research, in terms of testing predictions, is that it has been very difficult to audit the impacts predicted for developments. Impact predictions are not phrased in a way which allows auditing, and they can become obsolete very easily. In addition, existing monitoring programs are not very useful in providing data to allow predictions to be tested in a scientifically acceptable manner. The number of impacts audited is so small that generalization on "best" techniques and methods are impossible. It is clear, however, that the performance of the predictions in the three EISs is no better than the predictions made for the "non EIS" Cow Green reservoir project. Nor does it seem that predictive ability has improved between 1966 (Cow Green) and 1976 (Sullom Voe). Whether this state-of-affairs has improved in the interim is unknown and can only be answered by undertaking a further series of audits. The research has indicated defects in the EIA process and has suggested ways in which they can be removed and EIA improved.

Lessons for Future Practice

The results of the above study and the general conclusions that can be drawn from environmental audit studies in the U.K., and indeed in Canada and the U.S., suggest that a number of key issues have been identified and that these could be converted into action to help improve environmental assessment systems in general.

Baseline Studies

At present, baseline studies on the existing environments are often carried out in isolation from other EIA activities such as impact identification and prediction. Many EISs still consist of lists of facts or items, such as species lists, which are later "dipped into" when required during the impact prediction phase. The auditing work has shown the need for a higher level of linkage and integration between the various actions involved in EIA. The acquisition of baseline data should be iteratively linked with impact prediction and the likely requirements for impact monitoring.

Obtaining baseline data relevant to impact prediction is a very difficult task. In practice, as potential impacts are identified and assessed, the requisite baseline data can also be identified and collected. There is a "feedback" process in which the nature of the impacts determines the baseline data acquisition and baseline information helps aid impact identification and prediction. As more information on impacts is gathered, baseline data requirements become more precise.

As developments are imposed on dynamic environmental systems, impacts can only be considered in terms of the trends of the system(s) they may influence. A static baseline description is of no real value to EIA prediction. While the iterative process of refining baseline data requirements and the scope and nature of impacts is proceeding, it will become apparent which potential impacts should be monitored.

Assuming a project will proceed, it is necessary to set in motion "reference" station monitoring for sites expected to be unaffected by the particular impacts of concern. This "reference" monitoring will grow out of both the baseline data work and impact identification activities. In fact, "reference" monitoring stations should duplicate, as far as possible, stations established to obtain data. This should save both time and money. Paired "reference" and "affected" stations (measuring those parameters likely to undergo changes due to the development) can be established to aid conclusions on "cause-effect" relationships between a project and an environmental change. Through this procedure it is possible to set up "reference" stations indicating dynamic environmental trends and "affected" stations providing the same type of information (before project construction) as well as data on environmental parameters arising from development.

There is a fundamental problem in the above program for baseline studies. Since few audits have been implemented little is known about the accuracy of most types of impact predictions. The location of "affected" stations depends on predictions of impacts; for example, area to be affected, or target organisms. However, results from these stations are the only means of testing the accuracy of predictions. If the impact predictions were inaccurate because monitoring stations were located incorrectly, then the monitoring data would provide a false or incomplete picture of actual impacts. For impacts which can be identified visually this problem can be overcome, and monitoring stations adjusted accordingly. On the other hand, when impacts are detectable only be statistical analysis it is possible that they may be missed entirely, giving a false impression of the accuracy of predictions. Should this happen, then future monitoring, based on the existence of misleading information from past experience, might not provide the type of data required, as stations might be sited wrongly.

It is very clear that the writing/phrasing of predictions and their lack of specificity is a key issue. Support for this comes from a recent review of 21 EISs prepared in Canada. This study examined the utility and relevance of the ecological impacts in the EISs and concluded that prediction amounted to generalizations about the possible occurrence of a problem or the need for some corrective action to be taken (Beanlands and Duinker, 1983).

To overcome existing deficiencies in the way impact predictions are formulated and phrased it seems essential that they be treated as hypotheses which can be tested. Such hypotheses would force those preparing EISs to specify a number of aspects relating to time scale of impacts, probability of occurrence, and geographic extent of impacts. As well as ensuring that attention was paid to these aspects, formulation of hypotheses is essential for the interpretation of monitoring data needed for many types of impacts (for example, ecological effects).

A recent report indicates a type of EIA method which will help greatly to formulate impact predictions in the form of hypotheses which can be checked. This method, developed for aquatic ecological impacts, can be used to produce a hierarchy of predictions in the form of impact hypotheses to be tested (Fritz et al, 1980).

EIS Format

At present, EISs are normally produced at a single point in time during the history of a development and can only provide a "snapshot" of the design history of a project. All predictions relate to the characteristics of this "snapshot" of the design history of a project. Unfortunately, projects are dynamic entities which can, and often do, change over time. A "stationary" EIS is of limited value in a dynamic situation. To be able to accommodate project change and to update continually the nature of impacts expected from such an evolving project, it would appear necessary for an EIS to be adaptive to its context. Instead of being a single document, an EIS should perhaps be multi-document or take a loose-leaf form to enable additions and subtractions to be made. Only through such a continual, updating process is it possible to keep track of likely impacts and be sure that the links between project characteristics and impacts are correctly assigned through auditing.

Monitoring

Evidence from the U.K. suggests that monitoring schemes are not always directly related to expected impacts. Even when they are constituted to keep a track of impacts, changes in sampling design and sampling equipment have made interpretation of the different sets of results a difficult task (Bisset, 1981).

Before hypotheses can be tested, it is important that the basic features of sampling design are applied to monitoring. Hypotheses are usually tested by determining whether the variation caused by a hypothesized effect in an affected area as compared with an unaffected area is larger than would be expected if the null hypotheses of no change were true. To make this judgement, it is necessary to know the error variation, that is, the variation within each area.

This approach requires two basic features to be successful. First, replicate samples are needed within the same locality. For each location and for each time of sampling, it is necessary to have, for purposes of an impact study, at least three replicate samples. Replicate samples are needed to determine differences within a location. Differences between locations can be assessed only when differences within locations have been determined. Secondly, these must be randomly distributed within the locality.

The above discussion on hypothesis setting and monitoring is applicable to "biological" impacts on individual organisms or populations. These impacts are often the most difficult to identify and describe. Fortunately, such expensive and time-consuming monitoring programs may not be required for all impact predictions. In the U.K. case studies, there are a significant number of impacts which can be verified relatively easily.

Selection of Impacts for Auditing

Selection of impacts for auditing can be a problem and there are a number of ways of choosing such impacts. If an audit were being carried out to test specific predictive techniques, then the appropriate impacts would be audited. Such auditing can be undertaken for scientific purposes to improve knowledge of impacts. In most audits, it is likely that only impacts of special concern will be studied to identify deleterious effects early enough to take appropriate action. Such impacts could be chosen with public involvement. If this course were followed, it would be possible that certain impacts would be monitored which did not, in the opinion of the experts, require such attention. Alternatively, appropriate experts could be asked to identify those impacts requiring auditing. Finally, impacts could be selected for auditing on the basis of whether they could be mitigated by an appropriate controlling agency or authority. If there were no institutional mechanism for changing the course of a particular impact, it could be considered fruitless to monitor its progress unless monitoring were to increase knowledge.

Once it has been decided which impacts to monitor, it is useful to identify the type of change which the auditing will be able to identify. This is particularly essential for those impacts which may be economically important to local people and which can be influenced by a controlling authority. Also, there should be a time limit within which these changes must be found. Prior agreement on the magnitude of change to be detected should reduce possible disagreement on whether remedial measures are required.

Monitoring and auditing are long-term commitments and, ideally, require a constant institutional framework. It would be best if personnel establishing a monitoring program were to remain to carry it out, thereby maintaining consistency. However, staff turnover in both industrial companies and regulatory bodies is unavoidable. Staff changes may result in the invalidation of monitoring data through changes in sampling procedures. These can be altered, but only after calibration has been established through consultation with a statistician. Given the problem of personnel instability, those who initiate monitoring programs should commit the appropriate details to paper. They can then be used by staff replacements to ensure continuity.

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PART II

PUBLIC PARTICIPATION AND SOCIAL IMPACT

EVALUATION OF PUBLIC INVOLVEMENT IN PROJECT EIA IN THE NETHERLANDS

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Introduction

Following several years of preparatory work, the Dutch Government presented the Environmental Impact Assessment (EIA) Bill to Parliament on 21 May 1981. Within the Dutch constitutional framework, legislative power is shared by the Government and Parliament.

Starting in the late 1970's, there were a number of developments pointing in the direction of adopting EIA. While increasing attention was being given to the environmental consequences of proposed actions in planning and decision-making, it was generally recognized that the existing legislation could still be improved in a number of important areas.

The government decided that EIA could considerably improve the planning and decision-making process. EIA logically fits into and is able to strengthen ongoing developments. In the European Economic Community (EEC), moreover, a directive on EIA has been in preparation on an informal basis since 1978 and on a formal basis, i.e., in agreement with the Treaty of Rome, since June 1980. The discussion on this directive in the European Council of Ministers was finalized in March 1985, and it was adopted on June 27, 1985.

The twelve member States of the EEC (Belgium, Denmark, France, Federal Republic of Germany, Greece, Italy, Ireland, Luxemburg, the Netherlands, Portugal, Spain and United Kingdom) will have to implement EIA in their national legislations within a period of three years. For the Netherlands this will not cause problems since the Dutch Parliament approved the EIA-bill on the very same day of June 27, 1985. It will come into operation in mid-1986.

* This paper reflects the author's personal opinion.

The Dutch EIA Act

As part of the Dutch Government's environmental policy, the purpose of EIA is to ensure that in preparing and making a decision environmental aspects are taken into full consideration. EIA forces both the proponent and the decision-maker to find an optimal solution to environmental concerns. This objective makes EIA an instrument in the planning and decision-making process. It covers:

1) the preparation, review and application of an Environmental Impact Statement (EIS); and
2) the evaluation of the impacts once the decision has been made and the activity carried out.

Main Features of the EIA Act

In order to attain the above stated objectives, the Act contains various procedural provisions as well as requirements for the content of an EIS. Some main features of the Dutch EIA Act are the following:

- EIA will only be applied to decisions on types of activities included in a so-called positive list (see Table 1).
- EIA will be carried out prior to the decision of a governmental agency at the national, provincial or local level on a proposed activity. The decision-maker is therefore, the competent authority (cf. the U.S. "lead agency").
- The proponent of the activity is responsible for preparing the EIS. In some cases, the proponent and the competent authority will be the same body.
- EIA will be integrated in the existing decision-making procedures, and no new approval will be needed. Instead, the competent authorities will be required under the EIA legislation to take environmental aspects into consideration in making their decision.
- EIA will involve two phases of public participation; first, in the scoping phase, which takes place at the beginning of the procedure, and second, in the review phase, i.e., after the EIS has been accepted by the competent authority but before the decision is made.
- At the end of the scoping phase, the competent authority will assist the proponent by providing specific guidelines on the desired scope of the EIS (i.e., which alternatives and which impacts are to be studied).

TABLE 1 TYPES OF ACTIVITIES REQUIRING AN EIA IN THE NETHERLANDS

Activities, with main thresholds and frequencies per year		
1.	roads (four lane highways):	3
2.	railways:	0.4
3.	waterways (for ships over 1350 tons):	0.4
4.	harbours (over 100 hectares):	
5.	artificial islands (over 200 hectares):	
6.	airports (with runways of 1800 meters or more):	0.2
7.	military training areas (over 100 hectares):	0.5
8.	pipelines (in specific areas):	0.5
9.	re-allotment projects (in specific areas):	2
10.	recreation projects (over 20 hectares):	1
11.	urban extensions (over 2000 houses):	0.2
12.	dikes, dams, etc. (more than 2 km):	0.4
13.	reclamation/poldering (over 200 hectares):	
14.	changes in groundwater levels (over 30 cm):	
15.	water supply projects (over 10 million m^3):	0.7
16.	quarrying/excavations (over 100 hectares):	0.6
17.	extraction of fossil fuel (coal, lignite):	
18.	processing of (chemical) waste (over a certain capacity):	2.7
19.	dumping of chemical waste:	0.2
20.	industrial areas (over 100 hectares):	0.2
21.	large industrial projects (oil refineries, melting furnaces):	
22.	electric power stations (over 300 MW th):	0.6
23.	high voltage power lines (in certain areas, over 220 KV):	
24.	storage of LNG, coal and ores (over 50 hectares):	0.2
25.	coal gasification and liquefaction plants (over 250 000 tons of coal per year):	0.1
26.	withdrawal of the status of nature reserve:	
Total:		13.7

Anyone may give evidence at either stage of public participation. A special EIA Commission of independent experts will also be established in each case to advise on the content of the EIS during the scoping phase and to review the EIS when it has been completed and accepted by the competent authority. The Commission may not advise on the acceptability of the proposed activity, only on the quality of the EIS. Although the idea of an expert panel was taken from Canadian federal procedure, one might say its task is similar to the U.S. Environmental Protection Agency's review of EISs.
In making its decision, the competent authority has to justify its decision in such a way that it is clear how the information in the EIS was used in the decision-making process.

Content of an EIS

For the content of an EIS, the Act provides the following requirements:

1. As a minimum an environmental impact statement shall contain:

   a. a description of the purpose of the proposed activity;

   b. a description of the proposed activity and the manner in which it is to be carried out, together with a description of any reasonable alternatives;

   c. an indication of the decisions for purposes of which the environmental impact statement is being prepared and a survey of any earlier decisions by Government agencies having a bearing on the proposed activity and the alternatives described;

   d. insofar as the proposed activity or the alternatives described may affect the environment a description of the existing state of the environment as well as its predicted development should neither the activity nor the alternatives be carried out (i.e., the "do-nothing" alternative);

   e. a description of the effects on the environment which the proposed activity and the alternatives described respectively may have, together with grounds justifying the manner in which such effects have been determined and described;

   f. a comparison of the predicted development of the environment as described under <u>d</u> and the described environmental effects of the proposed activity and each of the alternatives considered;

g. a survey of omissions in the description given under d and e due to the lack of necessary information; and

h. a summary giving the layman sufficient insight to review the environmental impact statement and the effects described therein of the proposed activity and the alternatives described.

2. The alternatives described pursuant to subsection 1b above shall in all cases include the alternative offering the best prospects of protecting the environment, i.e., the environmentally preferred alternative.

3. The manner in which the data referred to in subsection 1 are to be determined and described may be regulated by General Administrative Order.

It is to be noted that a main element of the EIS will be the description of the "reasonable" alternatives for the proposed activity. These alternatives as well as their impacts on the environment have to be described. In addition, a comparison of the alternatives and the proposed activity will be part of the EIS.

In the EIA Act, the impacts on the environment include air, water, soil, plants, animals, man and properties, as well as the relationships between these elements and ecosystems. Moreover, cultural-historical, nature and landscape values may be included. Not only physical health but also mental health may be taken into account.

The Act sets the limits for the descriptions of environmental impacts. The precise impacts to be described in an EIS will be defined at the end of the scoping-phase.

Procedural Elements

In Figure 1 an outline of the procedural elements is given. In this figure, the proponent is a different organization from the competent authority. The proponent may be a private enterprise, but may also be a governmental agency (for example the Ministry of Public Works). The proponent and the competent authority can, however, be the same organization: for example a provincial agency preparing a waste management plan is also the agency competent to take a decision on this plan.

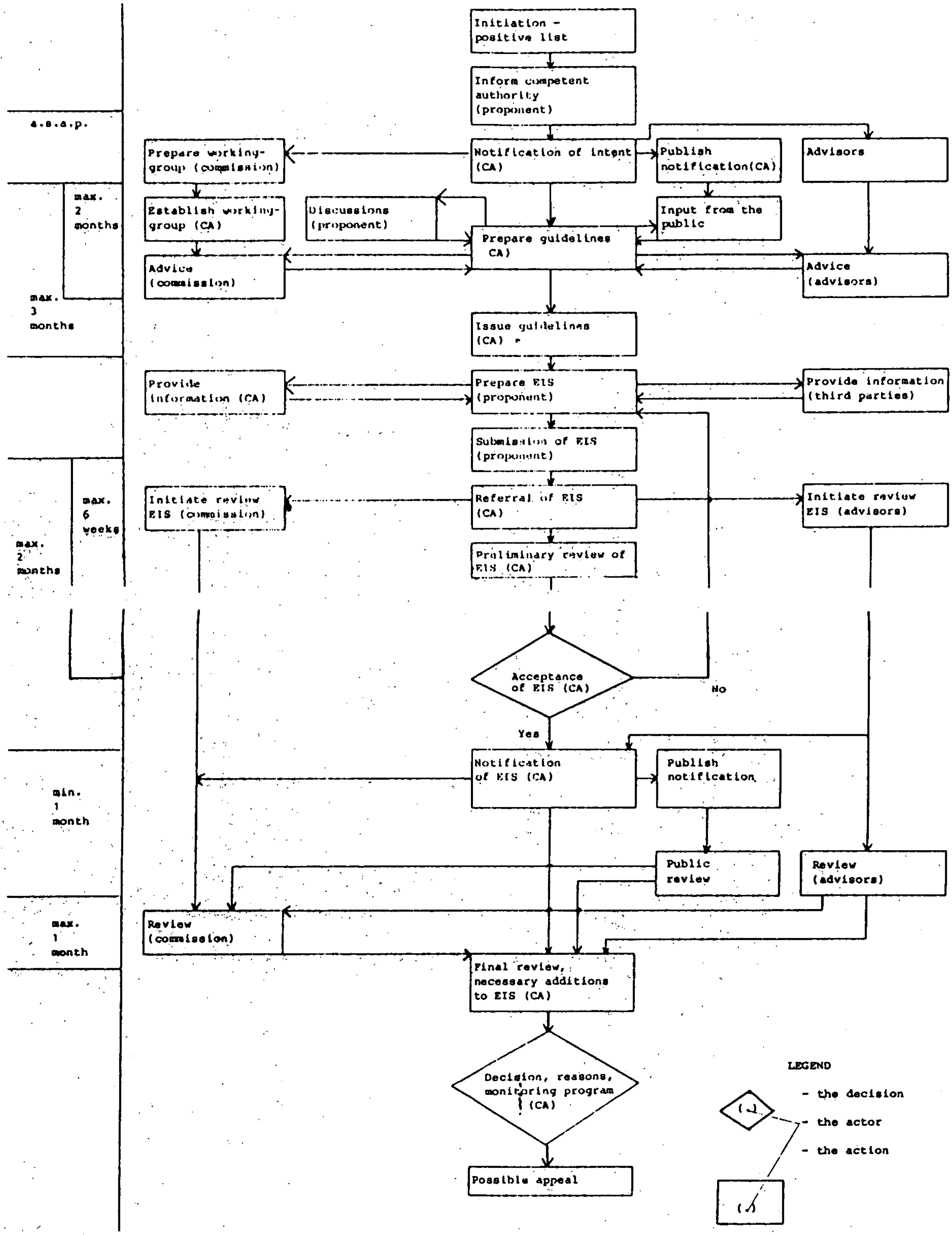

FIGURE 1 EIA PROCEDURE

EIA: Linking Science and Decision-Making

It should be pointed out that the EIA-system in the Netherlands not only contains provisions for scientific information, but also provisions for ensuring that this information is used in the decision-making process. This is achieved by requirements on the content of an EIA ("science") on the one hand and procedural requirements ("influence") on the other. The key article of the EIA Act is that no decision be taken unless both content and procedural requirements have been met.

In my opinion, it is very important that this link between science and decision-making is laid down in the Act; it provides a minimum guarantee against ignoring alternatives for, or unfavourable information on, a proposed activity. In this respect, one may think of phenomena such as attitudes in the proponent's and competent authority's organizations, "not invented here", political prejudice, etc.

First Experiences with Public Participation in EIA

Since 1981, the Netherlands Government has had an interim-policy on EIA, which has meant applying the procedures as if they had been law. In Table 2 an overview is presented of the cases of EIA-application.

Public Participation in the Scoping Phase

The EIA-procedure begins when a particular proponent (private or public sector) informs the competent authority of his intention to proceed with an activity. Once the "notification of intent" has been made, the scoping process begins. In addition to advisers and the EIA-Commission, the general public has the opportunity to bring forward ideas on alternatives that should be addressed in the EIS or concerns on potential environmental impacts that need special attention.

It should be noted that the general public may include individuals, environmental groups, other interest groups, and municipalities. Involvement of the public at this stage is a new phenomenon in the Netherlands. The EIA directive of the European Community, mentioned previously, does not contain any provisions for public involvement.

The reason for involving the public (as well as the EIA-commission) in the scoping phase was to avoid a situation in which new alternatives and new concerns on impacts would be brought into the decision-making process after the proponent

TABLE 2 EIA IN THE NETHERLANDS

A.	**Initiated EIA's**	
1.	Highway tunnel under Rotterdam Gateway	: in review phase
2.	Artificial peninsula in the North Sea for the disposal of contaminated harbour dredge	: decision taken
3.	Water quality (fresh or salt) Lake Grevelingen	: in decision phase
4.	Urban development project Amsterdam	: EIS under way
5.	Landfill Deventer region	: EIS under way
6.	Emmen Desulphurization plant	: decision taken
7.	Combined motorcross and shooting facility Breda	: EIS under way
8.	Interim storage of radioactive waste a. non-site specific b. site specific	: EIS under way
9.	Disposal of hazardous waste Maasvlakte	: EIS under way
10.	Runway extension Eelde Airport	: EIS under way
11.	Ommen Nitrogen plant	: EIS in review phase
B.	**EIA's to be initiated in 1985/1986**	
12.	Military training area Ede	
13.	Energy storage system a. choice of method b. site - selection	
14.	East - west runway Maastricht Airport	
15.	Province of North Brabant excavation plan	

had produced his EIS. Practice with several projects has taught us that such a situation leads to considerable delay and usually to trench warfare.

The EIA Act in the Netherlands leaves the question of how to involve the public to the competent authority. In the General Guidelines from the Ministry for the Environment, suggestions are presented on this issue. In the first EIA-cases the competent authorities took a traditional approach: a short announcement in the newspapers (the minimum requirement of the Act) that an EIA would be undertaken and the public could submit their written reaction within one month after publication of the announcement. During that time, information on the project could be obtained at different places (libraries, town halls) in the area. In addition to the newspaper announcement, the competent authority sometimes separately informed interest groups and local authorities.

In some cases, the information for the public was rather unstructured; this did not contribute to the quality of the public's input. Moreover it became clear from the reactions that the function of public involvement at that stage was not always well understood. So in later cases a special initiation paper was produced by the proponent (with the assistance of the competent authority) in which it was clearly stated what the scope of the EIS would be according to the proponent's view. The public could comment and make suggestions for change or elaboration.

In the recent case of the storage of radioactive waste, the Ministry for the Environment (competent authority) itself produced a special public participation information set including the initiation paper by the proponent, the most relevant policy documents, and an explanatory note on the exact function of the whole - very complicated - decision process and its subsequent steps. In almost all newspapers of the country, a rather lengthy announcement was made in which any interested person was invited to order this information set free of charge.

The number of participants in the scoping phase varied from ten to several hundred. Local authorities and professional environmental groups always participated. In addition, there were sometimes interventions by other interest groups (agriculture, industry, chamber of commerce) and individuals or action groups of individuals.

The maximum period of two months for public input turned out to be adequate for allowing relevant reactions.

Generally speaking, the public input in the scoping phase was of a serious character and of good quality. It drew attention to alternative sites and routes, alternative methods of operation and special environmental concerns.

These public inputs in the scoping phase can be looked upon simply as potentially interesting information for the further development of a project itself. Another perspective through which these inputs can be viewed is the indications they provide of future resistance and the pressures for a certain alternative which can be expected when the final decision is approaching. Our experiences in the Netherlands seem to indicate that the latter function of public involvement in the scoping phase can be regarded as being at least as important as the former one.

Starting with the first EIA, the competent authorities have developed the practice of explaining why they did not include suggestions for certain alternatives or measures in the specific guidelines which were the result of the scoping phase. This explanation was not foreseen in the Act. The elimination of serious alternatives at this stage has already lead to a discussion in the Environment Committee of the Dutch Parliament in one case and a recourse to the Administrative court in another case. In both cases the competent authority got its way. Moreover, it has become clear that the issuance of specific guidelines does not provide a juridically binding decision for the proponent, which means that there is no role for the courts. Only representative bodies (politicians) can make the competent authority change its mind, and this is not necessarily effective if the proponent is from the private sector or another authority (with its own representative body).

The above does not mean that public input has been neglected in the process of drafting specific guidelines. On the contrary, when there was no obvious principal conflict with established policy-lines, most suggestions from the public were included.

According to the Act, specific guidelines are made public together with the completed EIS. However, in conjunction with the need for public accountability, the competent authorities have developed the practice of immediately informing those members of the public who participated in the scoping phase. This is important for two reasons. First, it avoids giving the public the impression that their efforts are not taken seriously by the competent authority. Second, the public knows at an early stage what information the EIS is probably not going to include. This gives environmental groups and local authorities the opportunity for a timely development of their own preferable alternative which they think necessary. Of course, this mechanism only works if the specific guidelines are clear and are seriously followed.

Because the specific guidelines are not binding upon the proponent, the public has to be alert as to what really happens within the organization of the proponent. If the proponent is a government body, access by the public to this information will usually be easier than if the proponent is in the private sector. However, some government agencies have a "closed shop" culture much like the private sector.

In the Netherlands, we have had the experience that environmental groups and a local authority developed their own (site-specific) alternatives for a project once they perceived that the proponent was not going to seriously develop the alternatives that had been vaguely included in the guidelines on their suggestions.

Public Participation in the Review Phase

The Dutch EIA Act prescribes that the competent authority publish the EIS once it has accepted it from the proponent. This publication should be made simultaneously with the publication of an application for one or more licences or a draft decision when the competent authority is also the proponent.

Involvement of the public at this stage of the decision processes has been standing practice in the Netherlands for decades. To date, four EIA's have reached this stage. The traditional approach is an announcement in the newspapers. At a minimum, the public has a period of one month in which to comment in writing on the EIS and on the application or draft-decision.

In the review phase, a public hearing must also be held. In practice, the function of this hearing is more an outlet for public concern than an exchange of views and opinions. This is not surprising as proponent and competent authority (if not the same) have usually already come to some agreement on the principal issues of the decision. This can, and often does, lead to a situation in which the public is not submitting its views and opinions to an independent inquirer but to a decision-maker (or his representatives) who has already taken a stand.

However, the involvement of the public in the review phase can be very important for the final decision. This is due to three reasons. First, according to the EIA Act, in all cases the independent expert commission will express in its review as to whether comments from the public are valid. Our experiences seem to indicate that, where that is the case, those comments are taken seriously by the competent authority.

Second, in a considerable number of cases the public will have the right to make an appeal against the decision; for example on the grounds that the decision is unreasonable given the information provided or could not have been taken due to lack of essential information. An appeal can cause a delay in implementation of one or more years. Third, in all cases the public can address the representative body that supervises the competent authority. This is most effective before the decision is taken.

All three mechanisms give the public the opportunity to influence the decision-maker and thus the decision by pressures or threats. Moreover, the use of one or more of those mechanisms can be considered as a yardstick for the effectiveness of public involvement in the scoping phase. One might expect that the need for raising new issues, particularly alternatives, or criticism on proposed mitigation measures, diminishes the more the EIS (and licence application or draft-decision) reflects the public input in the scoping phase.

Our first experiences show that some issues are re-introduced by the public in the review phase. These are particularly issues that were not officially eliminated in the specific guidelines but were not elaborated in the EIS.

As stated above, in one case environmental groups and a local authority developed their own site-alternatives for a project once they found out that in spite of the specific guidelines, the proponent was not going to give serious attention to those alternatives. These alternatives were presented in the review phase of the EIA and they received a positive appraisal from the independent expert commission. In addition, these alternatives received some support from advisory bodies of the competent authority. With a confrontation with the Parliamentary Environment Committee in prospect, the competent authority adapted its first draft decision in such a way that the concerns of environmental groups and a potentially affected local authority were remedied to a large extent, even though their alternatives were rejected. The Parliamentary Environment Committee appreciated the new compromise as an excellent effort to protect the environment.

In a few cases, the concerns of the public came from uncertainties about environmental impacts of a project (risks for health and safety, unknown impacts on flora and fauna). In order to accommodate those concerns, there is a tendency to establish monitoring programs/post audits and to have their results published periodically.

Scepticism about Public Participation

Although the first experiences with EIA in the Netherlands seem to give evidence that inputs from the public are taken rather seriously, one must be careful in drawing firm conclusions and in expressing optimistic expectations. In this respect, there are recent examples of cases in which EIA could have been (but was not) applied in major policy decisions. One example is the extension of an airport which was decided upon by the Government under pressure from a group of Members of Parliament (supporting the Government) from the province concerned. They were MP's with a unilateral interest in the economic potential of the airport extension; they did not want to seriously consider the environmental consequences despite the protests from directly affected local communities (and their authorities) and environmental groups. So the decision was taken even before the official procedures (including public participation) for the airport extension started.

Another example is the case of new nuclear power plants. The Netherlands has only one nuclear power plant which went into operation in 1973. In the mid-1970's, the Government proposed to build another three plants. As a majority in Parliament was against any extension of nuclear power, it was decided (after long deliberations) that a so-called Broad Discussion on Energy Policy would take place. A specially established Steering Committee organized the most extensive public participation operation in our history. A budget of $13 million (Canadian) was spent and some 40 000 individuals and several hundred organizations participated in this discussion, which lasted over two years (1981-1984). The Steering Committee reported to the Government that a clear majority of the population was: 1) against new nuclear power plants as there is no solution to the final deposition of radioactive waste; 2) wanted investments in wind and solar energy; and 3) preferred environmentally sound coal-fired plants to nuclear ones.

Notwithstanding this outcome (which confirmed opinion polls over the years), a new Government with another majority in Parliament recently decided that the Netherlands is going to build another two to four nuclear power plants and accepted an interim storage of radioactive waste for 50-100 years. This decision was accompanied by all kinds of press-reports on agreements between some Ministers and some provincial authorities on the siting of those power plants as well as the storage of radioactive waste. Ignoring public participation in this case is presumably going to be one of the issues in the general election of May, 1986.

The above examples show that a certain scepticism is justified as to the effectiveness of public participation. A great many politicians in the Netherlands have a tendency to very clearly emphasize their own responsibility regardless of the results of public participation. This argument of responsibility was recently used in some highly controversial cases. Both in the case of nuclear power plants and in airport-extension project EIAs still to come, one can only wonder what public participation can mean if the go/no go decision cannot be discussed.

Conclusions

The number of completed EIA's in the Netherlands is too small to justify well-founded conclusions. In this paper tendencies are described that offer a preliminary view on EIA practice in the Netherlands. At least one thing is very clear: the effectiveness of public participation depends heavily on the attitude and behaviour of politicians. If they view public participation as being necessary only to "legitimize" the decisions taken in a democracy and not as a way of obtaining new information with at least the potential for affecting the decisions themselves, then public participation, regardless of its timing or the way it is structured, will be an empty exercise.

PUBLIC INVOLVEMENT IN THE BEAUFORT SEA ENVIRONMENTAL ASSESSMENT AND REVIEW PROCESS

Don Bissett
K. Bruce Waddell

Introduction

During the past two decades, the federal government has used public review processes as a prelude to decision-making on large scale northern development projects. The Beaufort Sea Environmental Assessment and Review Process (EARP) is the most recent example of such public review processes.

The Mackenzie Valley Pipeline Inquiry (MVPI), held in 1974-76, established something of a model in terms of procedures to encourage public participation. Public participation was encouraged through extensive information programs, intervenor funding and translation services. Hearings were divided into formal technical hearings in major northern and southern centres and less formal community hearings in small northern communities to encourage participation by native people.

Subsequent northern public reviews have used the public participation procedures introduced by the MVPI and extended the range of such procedures (Waddell, 1981). Table 1 indicates the types of public participation procedures used in northern public reviews of hydrocarbon and other development projects. It illustrates the expansion over time in the types of public participation procedures.

Federal Environmental Assessment Review Office (FEARO)-EARP and National Energy Board hearings have become standard public review processes for northern hydrocarbon development proposals. The advisory FEARO-EARP is based on an environmental impact statement (EIS) prepared by industry proponents, while NEB regulatory hearings deal with a broader range of licensing and technical matters and include environmental and socio-economic aspects.

Apart from the Panel considerations, there has been no detailed review of public participation in northern review processes. This paper examines the procedures used to encourage public participation in the Beaufort Sea EARP and the nature of public participation in the hearings. Hearing transcripts, written submissions and background materials produced by FEARO, government departments and recent commentaries by public interest groups were examined in the context of public input.

TABLE 1 NORTHERN PUBLIC REVIEW HEARINGS

Public Participation Features	DIAND		NPA	EARP								NEB		
	MVPI	AHPI	Alaska Highway Gas	South Davis Strait	Shakwak	Lancaster Sound	Alaska Highway Gas	Norman Wells Project	Arctic Pilot Project	Beaufort Sea	Slave River	Mackenzie Valley/ Yukon	Norman Wells	Arctic Pilot Project
	1976	1977	1979 (Jointly with EARP)	1978	1978	1978	1977, 79, 80 82-83	1980	1980	1983	1982	1977	1980	1980
Northern Office	x	x	x	-	-	-	-	-	-	x	-	-	-	-
Intervenor Funding														
-Native and Interest groups	x	x	-	-	-	-	-	-	x	x	-	-	-	x
-Northern communities	-	-	-	-	-	-	-	-	-	x	-	-	-	-
Consider Environmental Impacts	x	-	x	x	x	x	x	x	x	x	x	x	x	x
Consider Socio-economic Impacts	x	x	x	-	x	x	-	x	x	x	x	-	x	x
Technical Experts	x	x	-	-	-	-	x	x	x	x	-	-	-	-
Translation to Native Languages at Hearings	x	-	-	x	x	x	-	x	x	x	-	-	-	x
Advance Public Meetings														
-Operation Proc.	x	-	-	-	-	-	-	-	-	x	x	NA	NA	NA
-Community meetings	x	-	-	x	x	x	x	x	x	x	-	-	-	-
-workshops		-	-	-	-	-	-	-	-	x	-	-	-	-
Draft EIS Guideline Hearings	NA	NA	NA	-	-	-	-	-	-	x	x	NA	NA	NA
Interim Report	x	-	-	-	-	-	x	-	-	x	x	NA	NA	NA
Formal Technical Hearings (Regional Centers)	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Informal Community Hearings (Local communities)	x	x	x	x	x	x	x	x	x	x	x	-	-	-
Meetings - follow-up to final report	-	-	-	-	-	-	-	-	x	x	-	-	-	-

x feature used
\- feature not used
NA not applicable

Background

In the late 1970's, Dome, Esso and Gulf started planning for the production and transportation of hydrocarbons from the Beaufort Sea-Mackenzie Delta by 1988 at the earliest date. This followed an extended period of hydrocarbon exploration in the region which commenced in the 1960's. The Department of Indian Affairs and Northern Development (DIAND) initiated a FEARO/EARP review in 1980, in response to industry requests for some form of approval in principle. The purpose of the review was to identify potential environmental and socio-economic impacts and planning needs relating to potential Beaufort Sea - Mackenzie Delta hydrocarbon production and transportation. Dome, Esso and Gulf, as proponents, did not submit a specific proposal but rather advanced a range of possible oil production and transportation scenarios. These ranged from a 15 000 cubic metre per day production scenario with transportation by small diameter pipeline to a 200 000 cubic metre per day production scenario with large scale pipeline or icebreaking tanker transportation modes. Dome, Esso and Gulf provided a seven volume environmental impact statement (EIS), containing information on potential development systems, regional settings, biological and physical effects, socio-economic effects, accidental spills and research and monitoring.

Table 2 outlines the chronology of key events in the Beaufort Sea hearing process.

Procedures Used to Encourage Public Participation

A number of authors have characterized the Beaufort Sea EARP as an innovative advancement of the EARP impact assessment process and of public participation (Lawrence, 1983; Marshall and Scott, 1983; Rees, 1983). The following provides some details on the procedures used to encourage public participation in the Beaufort Sea EARP impact assessment process.

Both FEARO and the Beaufort Sea EARP Panel expended major efforts to encourage public participation in the review process. Specific public participation procedures included:

- Issues Seminar
- Intervenor Funding
- Draft EIS Guideline Hearings

TABLE 2 CHRONOLOGY OF THE BEAUFORT SEA EARP

July 1980	Minister of DIAND initiated formal public review of the Proponent's "concept proposal" to transport oil and gas from the Beaufort Sea to southern markets.
November 1980	FEARO held an "issues seminar" to identify preliminary environmental and socio-economic issues which were associated with the "concept proposal".
January-May 1981	Minister of the Environment appointed 7 members to the Beaufort Sea EARP Panel.
June 1981	Draft guidelines were released by the Panel to instruct the Proponents on the preparation of an EIS.
August 1981	DIAND sponsored intervenor funding program for Beaufort Sea EARP announced. FEARO administered program on experimental basis to provide financial assistance to those wishing to present their views to the Panel.
October 1981	A survey was conducted to identify kinds and sources of information which would be useful to the Panel, intervenors and Proponents. This resulted in a report, "Information Survey - Kinds and Sources for the Environmental Assessment and Review Process", which was widely circulated.
Nov.-Dec. 1981	Panel held public hearings, community and technical sessions, in Yukon and NWT and in Calgary to receive comments and suggestions on draft EIS guidelines.
February 1982	Panel issued final EIS guidelines for the preparation of an EIS.
April 1982	Panel issued Interim Report detailing its activities and requesting position statements from government departments.
May 1982	The report "Information Survey - Kinds and Sources for the Environmental Assessment and Review Process" was updated and circulated.
July-September 1982	Community workshops and meetings conducted by members of the FEARO secretariat and Panel in NWT and Labrador communities.
November 1982	Panel received the Proponents' seven volume EIS and the position statements from government departments.

TABLE 2 CHRONOLOGY OF THE BEAUFORT SEA EARP (Cont'd)

January 1983	A statement, "Where the Panel is Going", was issued to provide background material for persons involved in the review process.
January 1983	"Operational Procedures" for EIS hearings were given widespread distribution.
March 1983	Panel issued a Deficiency Statement, through DIAND, to the Proponents for additional EIS information.
June 1983	Proponents responded to the Deficiency Statement providing EIS Supplementary Information to the Panel.
August 1983	Panel decided there was sufficient information provided in the EIS Supplementary Information to proceed with the public sessions.
August 1983	Revised Terms Reference for the Panel issued.
September 1983	Panel held pre-session conference on EIS hearings in Yellowknife to finalize the draft schedule and agenda for the public sessions.
September-Dec. 1983	Panel held public EIS hearings, community and technical sessions, in Yukon, NWT, Calgary and Ottawa.
May 1984	Beaufort Sea EARP Evaluation Workshop.
July 1984	Panel issued Final Report.
November 1984	Beaufort-Mackenzie Delta DIZ draft report on community review of the Beaufort Sea EARP Panel released.
January 1985	GNWT response to the Beaufort Sea Environmental Assessment Panel report.
May 1985	DIAND initially responded to the Panel Report at the Arctic Petroleum Operators' Association Conference.

- Establishment of a Regional Information Office
- Information Dissemination
- Interim Panel Report
- Government Position Statements
- FEARO/Panel Community Meetings and Workshops
- Hearing Procedures

- Translation into Native Languages
- Technical Experts
- Panel Membership

FEARO (1980) sponsored an issues seminar in Calgary, in November 1980 and invited representatives from government, industry and interest groups. The seminar was intended to be a "scoping" exercise and initiate dialogue in terms of the planned review process. This occurred before the Beaufort Sea EARP Panel or it's terms of reference were established.

Substantial intervenor funding was provided by DIAND through an independent funding committee established by FEARO. Funding was provided to northern communities and can be considered innovative in terms of previous funding programs (see Graham et al., 1982). The amounts and recipients of intervenor funding are detailed in Appendix 1.

DIAND suggested that Draft EIS Guideline hearings be held and these took place in key northern communities and regional centres during November and December 1981. The hearings were intended to refine the Draft EIS Guidelines and incorporate additional information needs identified by the public and government. Additional information on the location of these hearings is provided in Appendix 2.

The FEARO secretariat to the Beaufort Sea EARP Panel established a regional office in Inuvik in 1982 and staffed it locally. The purpose of this office was to be a local, regional source of information on EARP and provide general support to the Panel activities.

The FEARO secretariat, including the Inuvik regional office, and the Panel provided numerous press releases, updates on activities and published reports and distributed publications and submissions to keep participants informed about the proposal, review process and public participation opportunities.

An interim report by the Beaufort Sea Environmental Assessment (EA) Panel (1982a) was released in April 1982. It addressed the matter of the Panel terms of reference, requested government position statements and responded to public concerns raised at the Draft EIS Guideline hearings (Beaufort Sea Environmental Assessment Panel, 1982b).

The Beaufort Sea Panel requested that 12 federal departments and the territorial governments provide position papers explaining their policies, plans and programs as they related to Beaufort Sea development. It was the first of the northern EARP Panels to request government department position statements.

These statements were translated into native languages and distributed for scrutiny by public participants.

Prior to final EIS hearings in September-December 1983, members of the Beaufort Sea EA Panel and Secretariat, which included the Inuvik regional office, visited small northern communities to explain the role of the review process and the proponents proposal. The information workshops were held to encourage public participation in the EIS hearings.

Informal community and more formal "technical" EIS hearings were held throughout the north and in regional centers in northern and southern Canada, respectively, in 1983. The Beaufort Sea EARP Panel issued hearing procedures for the community and technical hearings intended to assist the public in participating at the hearings. Details on the EIS hearings schedule are provided in Appendix 3.

Simultaneous translation services in native languages were made available to assist native northerners and encourage their participation in the hearings. Zonal summaries of the EIS were prepared by the proponent, at the request of the Panel, translated into native languages and provided to communities.

A staff of technical experts supporting the Panel was made available to public participants in the Beaufort Sea EARP hearings for consultation, information exchange and a discussion of issues.

The independent Beaufort Sea EA Panel, with its blend of northern scientific expertise and northern representation, constituted an innovation from earlier northern EARP Panels which were chaired by FEARO staff and had substantial government representation.

Identification of Public Comments

The contemporary literature on public participation does not provide any detailed identification or analyses of public comments at northern public review processes. The literature does, however, provide a basis to develop approaches for reviewing the massive amounts of information contained in the transcripts and written submissions for the Beaufort Sea EARP. Reasons suggested in the contemporary literature for engaging in public participation include (Connor, 1980): obtaining additional data important to planners; using technical expertise possessed by area residents; creative problem solving; receiving data on goals, attitude, value preferences and priorities; encouraging public involvement in planning; and, developing managerial solutions for environmental problems through changes in community behaviour. Public input in review processes has been described as dealing with the following subject matters (O'Riordan and O'Riordan, 1980): technical; cultural; social and amenity values, private property; social and amenity values; private; private property rights; and, local knowledge and expertise.

One of the main purposes of the EARP hearings was to review the proponents' EIS and to receive public comment on the adequacy, completeness and accuracy of this document. The following steps were carried out to identify and analyze public comments to the Beaufort Sea EA Panel:

1. identify the subject matter of public comments;
2. define the types of information provided in public comments;
3. develop groupings of public participants according to the role and focus of the participants;
4. develop a form to record the types and subject of information provided by the major groups of public participants.

The form provided in Table 3 was developed, based on the information contained in the proponent's EIS and the Final Report of the Beaufort Sea Environmental Assessment Panel (1984) to determine the role of public interest groups participation at the hearings in: providing new information; identifying where additional information was needed in the EIS; and, commenting on the adequacy and validity of the EIS based on the general focus of public concerns about the proponent's proposal.[1] Following testing, the form was used when reviewing each oral presentation and written submission by public participants at the Draft EIS Guideline and EIS hearings for the Beaufort Sea EARP. It records the types and subjects of information the participant groups provided to the Panel.

Public Interest Groups

Four primary groups of public interest participants in the Beaufort Sea EARP were identified. These consisted of: community residents; national and regional native organizations; municipal governments and local businesses in larger communities; and environmental and other interest groups. These groupings were used to consolidate information obtained on the types and subjects of information from participants with similar interests. A number of smaller organizations also participated in the review but by and large made single presentations or written submissions on an incidental basis.

TABLE 3 PUBLIC PARTICIPATION INPUT FORM

HEARINGS: ____________________

INTERVENOR: ____________________

	New Information Provided	Additional Information Required	Disagree with Info.	Agree with Info.	Concerns
<u>Oil Spills</u>					
General	___	___	___	___	___
Trajectory Modelling	___	___	___	___	___
Sensitivity Mapping	___	___	___	___	___
Clean-up Techniques	___	___	___	___	___
Dispersants	___	___	___	___	___
Biological Effects	___	___	___	___	___
Research	___	___	___	___	___
<u>Human Environment</u>					
General	___	___	___	___	___
SOCIAL EFFECTS					
General	___	___	___	___	___
Community Development	___	___	___	___	___
Northern Life-styles & Traditions	___	___	___	___	___
Alcohol Abuse	___	___	___	___	___
Money Management	___	___	___	___	___
Work Schedules	___	___	___	___	___
Social Services	___	___	___	___	___
REGIONAL POPULATION GROWTH MANAGEMENT					
General	___	___	___	___	___
Potential Population Growth Rates	___	___	___	___	___
Managing Construction Work Force	___	___	___	___	___
Expanded Rotational Employment	___	___	___	___	___
Temporary Construction Camps	___	___	___	___	___
Managing Transient Job Seekers	___	___	___	___	___
Managing Community Growth	___	___	___	___	___
New Communities	___	___	___	___	___
Project Abandonment	___	___	___	___	___

TABLE 3 PUBLIC PARTICIPATION INPUT FORM (Cont'd)

	New Information Provided	Additional Information Required	Disagree with Info.	Agree with Info.	Concerns
RESOURCE HARVESTING EFFECTS					
General	___	___	___	___	___
Importance of Resource Harvesting	___	___	___	___	___
Effects of Employment	___	___	___	___	___
Pressures on Resources	___	___	___	___	___
Resource Management	___	___	___	___	___
COMMUNITY SERVICES AND FACILITIES					
General	___	___	___	___	___
Municipal Services & Infrastructure	___	___	___	___	___
Housing	___	___	___	___	___
Local Energy Requirements	___	___	___	___	___
Sand & Gravel Resources	___	___	___	___	___
ECONOMIC EFFECTS					
General	___	___	___	___	___
EDUCATION AND TRAINING					
General	___	___	___	___	___
Education	___	___	___	___	___
Training	___	___	___	___	___
Facilities	___	___	___	___	___
EMPLOYMENT					
General	___	___	___	___	___
Northern Involvement	___	___	___	___	___
Cross Cultural Training	___	___	___	___	___
Job Motivation and Progression	___	___	___	___	___
Labour Force Estimation	___	___	___	___	___
Recruitment Programs	___	___	___	___	___
Union Practices	___	___	___	___	___
Employee Health & Safety	___	___	___	___	___
NORTHERN BUSINESS OPPORTUNITIES					
General	___	___	___	___	___
SOCIO-ECONOMIC IMPACT ASSESSMENT					
General	___	___	___	___	___

TABLE 3 PUBLIC PARTICIPATION INPUT FORM (Cont'd)

	New Information Provided	Additional Information Required	Disagree with Info.	Agree with Info.	Concerns
Assessment Methodology	___	___	___	___	___
Monitoring	___	___	___	___	___
Community Participation	___	___	___	___	___
Research	___	___	___	___	___
<u>Natural Environment</u>					
General	___	___	___	___	___
PROPOSAL EFFECTS ON THE ENVIRONMENT					
General	___	___	___	___	___
Changing Climate	___	___	___	___	___
Artificial Islands	___	___	___	___	___
Subsea Pipelines	___	___	___	___	___
PRODUCTION SYSTEMS					
General	___	___	___	___	___
Discharge of Formation Waters	___	___	___	___	___
Disposal of Drilling Wastes	___	___	___	___	___
Hazardous & Toxic Chemicals	___	___	___	___	___
Pressure Testing Fluids	___	___	___	___	___
Ballast and Bilge Water	___	___	___	___	___
Monitoring Fate of Pollutants	___	___	___	___	___
Ocean Dredging	___	___	___	___	___
Stabilization of Landfast Ice	___	___	___	___	___
Onshore Production Facilities	___	___	___	___	___
ARCTIC TANKERS					
General	___	___	___	___	___
Navigation	___	___	___	___	___
Effect of Icebreaking	___	___	___	___	___
General	___	___	___	___	___
Break-up & Freeze-up	___	___	___	___	___
Human Travel and Safety	___	___	___	___	___
Wildlife	___	___	___	___	___
Effects of Vessel Sound	___	___	___	___	___

TABLE 3 PUBLIC PARTICIPATION INPUT FORM (Cont'd)

	New Information Provided	Additional Information Required	Disagree with Info.	Agree with Info.	Concerns
Marine Support & Regulation					
Research & Preparation Stage					
Two Tanker Stage					
PIPELINES					
General					
Gas					
Small Diameter Oil					
Large Diameter Oil					
Construction Phase Effects					
Operation Phase Effects					
Corridors					
Rights-of-Way					
SUPPORT FACILITIES					
General					
Ports & Supply Bases					
Supply Operations					
Quarries					
Roads					
OFFSHORE BIOLOGICAL EFFECTS					
General					
Polar Bears					
Seals					
Whales					
Walrus					
Fish					
Marine Birds					
Benthic etc. Organisms					
Polynyas					
Effects of Vessel Sound					
ONSHORE BIOLOGICAL EFFECTS					
General					
Caribou					

TABLE 3 PUBLIC PARTICIPATION INPUT FORM (Cont'd)

	New Information Provided	Additional Information Required	Disagree with Info.	Agree with Info.	Concerns
Fish					
Birds					
Habitat Inventory					
ENVIRONMENTAL IMPACT ASSESSMENT					
General					
Assessment Methodology					
Monitoring					
Research					
General					
Oceanographic					
Oil Effects-Marine Mammals					
Oil Effects-Terrestrial Mammals					
Marine Mammals					
Marine Mammal Habitat					
Fish					
Fish Habitat					
Birds					
Bird Habitat					
Terrestrial Mammals					
Terrestrial Mammals Habitat					
Integrated/Interdisciplinary					
Compensation					
General					
Government Management					
General					
Local Control					
Project Coordination					
Planning					
Government Contingency Plans					
Vessel Traffic Management					

TABLE 3 PUBLIC PARTICIPATION INPUT FORM (Cont'd)

	New Information Provided	Additional Information Required	Disagree with Info.	Agree with Info.	Concerns
Port Authorities					
Impact Funding					
Revenue Sharing					
Government Research					
Monitoring					
Surveillance					
Archeological Resources					
Technical Expertise					
Other Developments					
Further Public Reviews					
Aboriginal Claims					
International Considerations					
<u>EARP</u>					
General					
Operational Procedures					
Public Sessions					
Government Participation					
Technical Specialists					
Public Files/Information					
Intervenor Funding					

Community Residents

Community residents, both native and non-native, as well as local organizations, such as the Hunter and Trapper Associations and Development Review Committees, participated in the hearings. Their statements reflected a distinctly local/regional focus. Representatives from smaller communities that were not on the Panel's itinerary, such as Grise Fiord, Broughton Island, Arctic Red River and Labrador communities, were transported to hearing locations.

Northern residents in the smaller communities have become familiar with hydrocarbon exploration activities and EARP. For example, high eastern arctic communities were familiar with Panarctic hydrocarbon exploration activities through employment and the Lancaster Sound and Arctic Pilot Project EARP reviews. All of the Beaufort Sea-Mackenzie Delta communities had a long exposure to hydrocarbon exploration activities and residents participated through training, employment and business activities. They also participated actively in the earlier Mackenzie Valley Pipeline Inquiry. The Mackenzie Valley communities have also been exposed to extended hydrocarbon exploration activities, the Mackenzie Valley Pipeline Inquiry and the Norman Wells Project. In many cases, statements by community residents appear to have been a reiteration of concerns expressed at earlier public reviews; however, more positive attitudes toward development were observed. An increasing degree of sophistication and use of written materials was observed in the community participation.

Native Organizations

National and regional native organizations, having participated in the earlier EARP hearings, were thoroughly familiar with the intent and focus of EARP. These organizations included the Dene Nation, the Delta Dene Regional Council, Inuit Tapirisat of Canada, Council for Yukon Indians, the Labrador Inuit Association, Baffin Region Inuit Association and the Metis Association of the Northwest Territories. The single presentations by groups representing the interests of native people, such as the Native Women's Group in Inuvik, were included in this group. Participation occurred in both oral and written form and focussed on the technical hearings, although regional affiliates participated at some community hearings. They formed an articulate and incisive participant group presenting viewpoints on the EIS and proponent's proposal, as well as on broader issues beyond the scope of the review.

Interest Groups

Northern and southern environmental interest groups collaborated in forming the Beaufort Sea Research Coalition (BSRC) which was made up of the Canadian Arctic Resources Committee, the Arctic International Wildlife Range Society, the Canadian Nature Federation, Energy Probe and the Yukon Conservation Society. The BSRC and its successor, the Beaufort Sea Alliance which included the Arctic International Wildlife Range Society, Energy Probe and the Yukon Conservation Society, pooled strategies, expertise and financial resources of the member groups in addressing the EIS and participating in the hearings. Following difficulties and misunderstandings regarding intervenor funding levels, the Canadian Arctic Resources Committee and the Canadian Nature Federation withdrew from the Beaufort Sea Research Coalition early in the Beaufort Sea EARP. The remaining three groups formed a new coalition which was renamed the Beaufort Sea Alliance. The Beaufort Sea Alliance then formed a loose alliance with native organizations for the purpose of information exchange and developing general strategy. Environmental groups also participated independently at the technical hearings. This group included other interest groups participating in the hearings, such as historical and museum groups and ski clubs.

Municipal Governments and Local Businesses

Municipal governments and local businesses in the larger northern communities, such as Inuvik, Whitehorse and Yellowknife, participated at hearings in their home locations to promote development. As such, they performed as a lobby group for development and did not make a major contribution to the environmental evaluation process.

Observations on Public Comments

Public comments at the Beaufort Sea EARP hearings, both the Draft EIS Guideline and EIS hearings, dealt with most of the subject areas addressed in the proponent's EIS and focussed on the scale, pace and type of acceptable northern hydrocarbon development within the context of the various scenarios advanced in the EIS (DIAND, 1984a, b). The results of the detailed review of each oral presentation detailed in the hearing transcripts and in excess of 120 written submissions by all individuals and public groups at the Beaufort Sea EARP hearings are summarized in Tables 4, 5 and 6. These results provide valuable insights regarding the nature of public input to the Panel at the Draft EIS Guideline and EIS hearings and indicate the possible influence of public participation on the Panel recommendations.[2] This review, while including the Draft EIS Guideline hearings, concentrates on the public comments at the EIS hearings since these were more numerous.

TABLE 4 SUMMARY OF PUBLIC COMMENTS PRESENTED AT THE DRAFT EIS GUIDELINE HEARINGS

Types of Information Provided	Community Residents	Mun. Gov.'t & Local Bus.	Native Groups	Interest Group	Total
New Information Provided	14	1	-	1	16
Additional Information Needed	52	10	3	-	65
Disagree with Information	2	-	-	-	2
Agree with Information	2	-	-	-	2
Concerns	91	20	40	29	180
Total	161	31	43	30	265
Subject of Public Input					
Oil Spills	11	1	2	1	15
Human Environment	53	18	7	1	79
Natural Environment	70	-	7	4	81
Compensation	2	-	-	-	2
Government Management	24	5	12	13	54
EARP	1	7	15	11	34
Total	161	31	43	30	265

TABLE 5 SUMMARY OF PUBLIC COMMENTS PRESENTED AT THE EIS HEARINGS

Types of Information Provided	Community Residents	Mun. Gov.'t & Local Bus.	Native Groups	Interest Group	Total
New Information Provided	99	16	42	10	167
Additional Information Needed	157	-	49	2	208
Disagree with Information	8	3	28	23	62
Agree with Information	18	6	4	3	31
Concerns	616	201	681	403	1901
Total	898	226	804	441	2369
Subject of Public Input					
Oil Spills	77	8	33	13	131
Human Environment	349	105	260	121	835
Natural Environment	308	34	205	161	708
Compensation	34	1	28	3	66
Government Management	118	72	266	129	585
EARP	12	6	12	14	44
Total	898	226	804	441	2369

Draft EIS Guideline Hearings

Table 4 summarizes the 265 recorded public comments at the Draft EIS Guideline hearings, according to the types of information and the subject of input by each of the four groups of public participants. Community residents provided more than 60% of the comments, while native organizations, municipal governments and local businesses and interest groups accounted more or less equally for the remainder. Almost 70% of the comments dealt with concerns and 25% indicated additional information needed. These comments concentrated

TABLE 6 SUBJECT AREA OF COMMENTS BY PUBLIC PARTICIPANT GROUPS AT THE EIS HEARINGS

	Community Residents	Mun. Govt. & Local Business	Native Groups	Interest Groups
<u>Oil Spills</u>				
General	33	7	17	4
Trajectory Modelling	3	-	1	-
Sensitivity Mapping	1	-	-	-
Clean-up Techniques	15	1	6	5
Dispersants	6	-	2	1
Biological Effects	16	-	5	2
Research	3	-	2	1
<u>Human Environment</u>				
General	10	6	4	6
SOCIAL EFFECTS				
General	17	10	14	18
Community Development	4	3	16	3
Life-styles & Traditions	14	2	23	10
Alcohol Abuse	16	4	9	1
Money Management	5	1	-	-
Work Schedules	6	-	2	1
Social Services	10	3	8	2
REGIONAL POPULATION GROWTH MANAGEMENT				
General	-	-	-	1
Potential Population Growth Rates	2	1	-	3
Managing Construction Work Force	2	-	2	1
Expanded Rotational Employment	2	-	1	-
Temporary Construction Camps	3	3	1	-
Managing Transient Job Seekers	2	1	-	2
Managing Community Growth	9	5	2	3
New Communities	1	-	1	-
Project Abandonment	1	4	2	2

TABLE 6 SUBJECT AREA OF COMMENTS BY PUBLIC PARTICIPANT GROUPS AT THE EIS HEARINGS (Cont'd)

	Community Residents	Mun. Govt. & Local Business	Native Groups	Interest Groups
RESOURCE HARVESTING EFFECTS				
General	10	2	4	3
Importance of Resource Harvesting	23	2	26	8
Effects of Employment	2	1	2	2
Pressures on Resources	6	2	5	5
Resource Management	7	1	12	2
COMMUNITY SERVICES AND FACILITIES				
General	4	3	1	-
Municipal Services & Infrastructure	11	7	6	-
Housing	8	3	2	-
Local Energy Requirements	-	-	1	-
Sand & Gravel Resources	-	-	1	-
ECONOMIC EFFECTS				
General	14	-	13	-
EDUCATION AND TRAINING				
General	2	1	12	-
Education	16	4	8	1
Training	29	8	18	-
Facilities	12	2	5	1
EMPLOYMENT				
General	27	-	15	5
Northern Involvement	18	3	12	2
Cross Cultural Training	7	-	-	-
Job Motivation and Progression	5	-	-	1
Labour Force Estimation	-	-	-	1
Recruitment Programs	9	-	-	-
Union Practices	7	-	1	-
Employee Health & Safety	3	-	2	-
NORTHERN BUSINESS OPPORTUNITIES				
General	4	11	8	1
SOCIO-ECONOMIC IMPACT ASSESSMENT				
General	7	-	5	8

TABLE 6 SUBJECT AREA OF COMMENTS BY PUBLIC PARTICIPANT GROUPS AT THE EIS HEARINGS (Cont'd)

	Community Residents	Mun. Govt. & Local Business	Native Groups	Interest Groups
Assessment Methodology	-	-	1	6
Monitoring	1	-	-	-
Community Participation	1	1	-	1
Research	1	-	1	-
<u>Natural Environment</u>				
General	5	2	21	8
PROPOSAL EFFECTS ON THE ENVIRONMENT				
General	5	3	3	16
Changing Climate	-	-	-	-
Artificial Islands	9	3	1	-
Subsea Production	1	-	-	-
PRODUCTION SYSTEMS				
General	-	-	-	7
Discharge of Formation Water	-	-	-	-
Disposal of Drilling Wastes	1	-	-	-
Hazardous & Toxic Chemicals	2	-	-	-
Pressure Testing Fluids	-	-	-	-
Ballast and Bilge Water	-	-	-	-
Monitoring Fate of Pollutant	-	-	-	1
Ocean Dredging	1	1	-	1
Stabilization of Landfast Ice	1	-	-	-
Onshore Production Facilities	1	-	-	-
ARCTIC TANKERS				
General	14	2	21	10
Navigation	1	-	12	1
Effect of Icebreaking				
General	15	-	4	1
Break-up & Freeze-up	12	-	1	1
Human Travel and Safety	20	-	2	1
Wildlife	15	1	2	2
Effects of Vessel Sound				

TABLE 6 SUBJECT AREA OF COMMENTS BY PUBLIC PARTICIPANT GROUPS AT THE EIS HEARINGS (Cont'd)

	Community Residents	Mun. Govt. & Local Business	Native Groups	Interest Groups
Marine Support & Regulation	4	-	3	1
Research & Preparation Stage	6	-	3	-
Two Tanker Stage	11	-	-	1
PIPELINES				
General	20	2	9	2
Gas	-	-	-	-
Small Diameter Oil	-	-	1	4
Large Diameter Oil	-	1	2	3
Construction Phase Effects	-	-	-	-
Operation Phase Effects	-	-	-	-
Corridors	-	-	1	2
Rights-of-Way	2	1	6	3
SUPPORT FACILITIES				
General	2	1	1	2
Ports & Supply Bases	4	1	1	12
Supply Operations	-	-	-	1
Quarries	-	-	-	8
Roads	-	1	1	7
OFFSHORE BIOLOGICAL EFFECTS				
General	10	3	10	6
Polar Bears	12	-	4	1
Seals	20	-	8	1
Whales	13	-	3	3
Walrus	4	-	5	-
Fish	8	-	2	-
Marine Birds	6	-	1	1
Benthic etc. Organisms	4	-	3	1
Polynyas	-	-	2	-
Effects of Vessel Sound	23	-	13	5
ONSHORE BIOLOGICAL EFFECTS				
General	5	5	4	9
Caribou	5	-	1	7

TABLE 6 SUBJECT AREA OF COMMENTS BY PUBLIC PARTICIPANT GROUPS AT THE EIS HEARINGS (Cont'd)

	Community Residents	Mun. Govt. & Local Business	Native Groups	Interest Groups
Fish	8	-	3	2
Birds	5	-	-	1
Habitat Inventory	1	-	1	1
ENVIRONMENTAL IMPACT ASSESSMENT				
General	-	3	9	18
Assessment Methodology	-	1	1	5
Monitoring	1	1	2	2
Research				
General	4	1	8	2
Oceanographic	-	-	20	-
Oil-Marine Mammals	3	-	-	-
Oil-Terrestrial Mammals	-	-	-	-
Marine Mammals	3	-	-	-
Marine Mammal Habitat	3	-	-	-
Fish	2	-	1	-
Fish Habitat	2	-	-	-
Birds	4	-	1	-
Bird Habitat	-	-	-	-
Terrestrial Mammals	-	-	-	-
Terrestrial Mammal Habitat	-	-	-	-
Integrated/Interdisciplinary	-	-	-	-
Compensation				
General	24	1	28	3
Government Management				
General	14	21	37	35
Local Control	17	17	49	18
Project Coordination	5	15	19	11
Planning	8	3	11	17
Government Contingency Plans	6	-	3	1
Vessel Traffic Management	2	1	6	-

TABLE 6 SUBJECT AREA OF COMMENTS BY PUBLIC PARTICIPANT GROUPS AT THE EIS HEARINGS (Cont'd)

	Community Residents	Mun. Govt. & Local Business	Native Groups	Interest Groups
Port Authorities	1	-	2	-
Impact Funding	10	2	9	4
Revenue Sharing	8	4	13	-
Government Research	5	1	18	3
Monitoring	8	2	23	1
Surveillance	4	2	6	1
Archeological Resources	-	-	2	-
Technical Expertise	1	-	4	1
Other Developments	4	-	11	2
Further Public Reviews	4	-	15	14
Aboriginal Claims	17	2	41	18
International Considerations	4	-	7	3
EARP				
General	4	2	3	7
Operational Procedures	2	1	5	7
Public Sessions	5	2	1	-
Government Participation	-	-	-	-
Technical Specialists	-	-	1	-
Public Files/Information	-	-	-	-
Intervenor Funding	1	1	2	-

Figures listed under each group of public participants represent the total number of comments provided by the group during the EIS hearings in each of the identified subject areas.

equally on the natural and human environments, followed closely by comments on government management and EARP.

EIS Hearings

Table 5 identifies the 2369 expressions of public concern, in terms of the types of information and the subject of inputs by each of the public participant groups, recorded for the EIS hearings. Statements of concern accounted for 80% of these comments. The bulk of comments, almost 90%, dealt with the human and natural environments and with government management.

Table 6 provides further details on the subject of comments by public groups at the EIS hearings and shows that community residents and native organizations provided an equally large number of comments, followed by interest groups and municipal governments and local businesses. It also shows that the focus of comments varied, as expected, between each of the groups.

Community Residents

Community residents made the greatest number of comments at the hearings (898), providing more than five times as many comments as they did at the Draft EIS Guideline hearings.

Residents indicated concerns and identified needs for additional information in the areas of oil spills, northern employment, effects of arctic tankers on human travel and safety, offshore biological effects, compensation and aboriginal land claims. Additional information needs were also identified regarding the effects of arctic tankers, research on marine and terrestrial mammals and fish, planning and monitoring development, impact funding and further public reviews of Beaufort Sea development. Community residents provided new information and expressed specific concerns to the Panel on increased alcohol abuse resulting from development, resource harvesting, education, training and employment of northerners and possible onshore and offshore biological effects of development. New information was also provided concerning work schedules, the economic effects of development and the effects of icebreaking. Community residents also focussed on concerns about the social effects of development, managing community growth and municipal services and infrastructure needs, economic effects, environmental effects of artificial islands and local control of development.

While there were many similarities among comments by community residents, regional differences were observable. The Beaufort and eastern arctic communities expressed concerns and requested additional information about tanker traffic and oil spill effects on marine wildlife harvesting and resources and implications for Greenlandic Inuit who also rely on marine wildlife. The eastern arctic communities provided new information about wildlife habits and habitat. Beaufort communities raised concerns and requested additional information about the social effects of development, demands on community services and facilities and local employment opportunities more frequently than other communities. Mackenzie Valley and mainland Beaufort communities stated concerns and requested additional information dealing with the effects of pipelines on wildlife harvesting, notably caribou.

Community residents and local organizations participated at the informal hearings in their home communities and in the more formal technical hearings at Resolute, Inuvik, Whitehorse and Yellowknife. Participation rates observed at the community hearings varied widely among communities with Old Crow and Nain having the highest participation rates. Beaufort and eastern arctic communities expressed substantial concerns about technical aspects of the proponent's proposal as well as potential socio-economic and environmental impacts. A general overview of community comments at the EIS hearings is provided in Table 7.

Native Organizations

The 804 comments by native groups accounted for nearly as many of the comments at the EIS hearings as did the community residents. Roughly 85% of their comments dealt with concerns about the effects of development on the human and natural environments and government capabilities to manage development.

The need for additional information and concerns were expressed in regards to education and training and the offshore biological effects of tankers. Native groups provided new information to the Panel on northern life-style preferences, community development and social services, education, training and employment needs, possible offshore biological effects and new oceanographic information. Specific concerns focussed on oil spills, northern life-styles, resource harvesting effects, economic effects, education, training, and employment of northerners, arctic tankers, compensation, government research, monitoring, EARP, further

TABLE 7 GENERAL OVERVIEW OF COMMUNITY COMMENTS AT THE EIS HEARINGS

Community	No. of Participants	Comments
		Beaufort Sea/Mackenzie Delta Communities
Aklavik	9	- concerned about training, type of employment - queried who would follow up on band's recommendations - support for pipeline not tanker - concern about alcohol abuse
Sachs Harbour	8	- concern about effects of shipping on seals - oil spill controls needed - want final say in any development approvals - need for adequate consultation
Holman	8	- want reasonable controls on shipping - need oil spill planning - want tankers rerouted around Banks Island away from Prince of Wales Strait - EIS is more speculation than prediction - want compensation - queried abandonment of project - suggested government policies should be directed to minimize damage - commented on social impact of employment away from communities - queried risk probability factor
Coppermine	4	- Hunter Trappers Association supports pipeline rather than tanker - requested info on Tuk Tek - concern about impact of oil spill on wildlife
Paulatuk	5	- development could be beneficial - some fear of environmental damage - development could change life-style - ice track crossings appear feasible - queried wildlife studies in Proponents' EIS
Tuktoyaktuk	15	- wish to be consulted, have input into all aspects of development - compensation packages not always adequate - support pipeline rather than tankers - training, employment opportunities should be reviewed

TABLE 7 GENERAL OVERVIEW OF COMMUNITY COMMENTS AT THE EIS HEARINGS (Cont'd)

Community	No. of Participants	Comments
		Beaufort Sea/Mackenzie Delta Communities (Cont'd)
Tuktoyaktuk (Cont'd)		- concern about ice buildup around artificial islands - need for municipal share of revenue - need for monitoring
Inuvik	22	- concerns focussed on community needs and problems, recreation, land protection, deterioration of housing - concern about suicide rates - concern about current lack of resources to deal with impacts
Fort McPherson	10	- Dene don't want oil companies on Dene land - Dene depend on wildlife - game scarce after oil companies arrive - damage to environment done by oil companies - development must be done properly - pipeline will conflict with traplines
		Mackenzie Valley
Fort Franklin	9	- lack of consultation with Dene regarding Colville Lake exploration - Dene are looking at business opportunities - government doesn't keep promises - pipeline only after land claims - people have not benefitted from development - spoke about problem of alcoholism
Fort Norman	11	- concern about land, environment, impacts on wildlife - concern about proposals for pipeline, dams - fear of oil spills - concern about seismic operations - difficulties in getting work - need better education - need for consultation
Norman Wells		- pointed out need for accelerated training, skills development - need to develop long range planning to spread impacts

TABLE 7 GENERAL OVERVIEW OF COMMUNITY COMMENTS AT THE EIS HEARINGS (Cont'd)

Community	No. of Participants	Comments
		Mackenzie Valley (Cont'd)
Norman Wells (Cont'd)		- not enough information to comment on pipeline scale - concern about spills - need to set up project monitoring - problems related to alcohol/drug abuse - general query re benefits industry prepared to offer people
Fort Simpson	9	- development conflicts with Dene interests and land claims - community overbuilt on premise of earlier pipeline proposal - fear oil spills, pollution - want oil spill prevention at pipeline water crossings - pointed out lack of education - want to participate in decision-making
Fort Good Hope	10	- provided Panel with information on land use research - said large scale development needs more care, more studies - land claims should be settled - compensation should be available - deficiencies in oil spill contingency planning - need monitoring - fear of Mackenzie River dredging impacts - pointed out pressures resulted from oil exploration Colville Lake - Norman Wells Project accounts for half social problems
		Eastern Arctic
Resolute	9	- concern about ships tracks, ice crossing - queried how hunters would see ships in darkness, storms - queried whether there would be compensation - pointed out lack of studies to locate seal birth lairs

TABLE 7 GENERAL OVERVIEW OF COMMUNITY COMMENTS AT THE EIS HEARINGS (Cont'd)

Community	No. of Participants	Comments
		Eastern Arctic (Cont'd)
Arctic Bay	17	- tanker capabilities in multi-year ice not known - dispersants, ignitors may not work in open water, moving ice, winds - pipeline better than tankers - oil spills by tanker may be massive - want compensation - Inuit need education - questioned requirements for working on ice breaking tankers
Pond Inlet	21	- importance of wildlife - major concerns about impacts on marine life - concern about education - concern about noise and oil spills, ship tracks - development too fast - queried what's in it for Inuit - concern about oil spill statistics - concern about unions - queried compensation
Pangnirtung	10	- concern about potential damage to environment by ice breaking tankers - queried employment opportunities on tankers - queried oil spill effects on polar bears - queried route of tankers
Frobisher Bay	7	- queried Proponents' position on land claims - how Proponents propose to avoid beluga, narwhal in migration and overwintering areas - limited and imperfect use of Inuit knowledge
		Labrador
Nain	30	- concern about oil spills - concern about shipping impacts on Labrador sea and coast - concern about impact on fish stock - need for compensation for spills - more environmental information needed

TABLE 7 GENERAL OVERVIEW OF COMMUNITY COMMENTS AT THE EIS HEARINGS (Cont'd)

Community	No. of Participants	Comments
		Yukon
Old Crow	25	- concern about possibility of oil spills - concerned about potential of construction on North Slope, oil pipeline along Dempster - concern about social impacts from haul road, north slope port - need for north slope port - need for compensation - need to protect land and animals - dependence on caribou - concern about environmental impacts and use of heavy equipment - need for alcohol training - companies need to learn from local people

public reviews, and aboriginal claims. (The Inuvialuit land claims settlement was concluded in 1984, after the completion of the hearings.)

The Dene Nation appeared in the Inuvik and Yellowknife technical hearings as well as at some community hearings. They recommended a small buried pipeline, pointed out that changes were occurring too fast and causing problems for the Dene people, reiterated a need for a land claims settlement prior to development occurring, and suggested a Dene partnership in development. Inuit Tapirisat of Canada (ITC), which appeared at the technical sessions in Resolute and Ottawa, pointed out the weakness of the oil spill risk analysis contained in the EIS, queried oil spill clean-up capabilities, and highlighted the difficulties faced by native northerners, due to language, training and cultural barriers, both in terms of participation in northern public review processes and northern business and employment opportunities associated with northern development projects. The Baffin Region Inuit Association (BRIA) participated at the technical sessions in Resolute and Ottawa, as well as at the community hearing in Frobisher Bay, and focussed on potential noise impacts and the need for information on long range impacts on wildlife and the severity of weather and ice conditions for ice-breaking oil tankers. BRIA also indicated that the Inuit were opposed to the proposal, questioned the proponent's oil spill clean-up capabilities, provided the Panel with information on its wildlife harvesting studies and pointed out the limited and improper use of Inuit knowledge and the lack of appropriate research in northern communities. The Labrador Inuit Association (LIA) appeared at the technical sessions in Resolute and Ottawa and coordinated the Inuit research presentation to the Panel at its Nain community hearing. LIA focussed on the potential problems associated with winter clean-up of oil spills in sea ice, questioned the location of the shipping corridor in relation to native wildlife harvesting areas and lobbied for a forum to enable the Labrador Inuit continuing opportunities to present their concerns about shipping in the Labrador Sea. The Council for Yukon Indians and the Metis Association of the NWT played insignificant roles in the Beaufort Sea EARP hearings, both in terms of the level and nature of their participation. The Council for Yukon Indians diverted its intervenor funds to assist the community of Old Crow. The Metis Association of the NWT used only part of its intervenor funds, and those that were used ended up supporting a community liaison and information program.

An indication of the range of comments expressed by native organizations is provided in Table 8.

Interest Groups

More than 90% of the interest group comments at the EIS hearings raised specific concerns about the effects of development on social, resource harvesting and economic affairs, identified problems with the proponent's socio-economic and environmental impact assessments, and addressed issues relating to onshore biological impacts, government management, local control, planning, further public reviews and aboriginal claims. Interest groups also provided new information and expressed concerns about support facilities, particularly those proposed for the Yukon North Slope, and offered comments on EARP.

Interest groups participated at the Inuvik, Ottawa, Whitehorse and Yellowknife technical hearings with the most sustained participation being provided by the Beaufort Sea Alliance (BSA). The BSA raised major concerns about the environmental assessment process and its lack of scientific rigour, using expertise internal to their organizations as well as expertise contracted for the purpose, and commented on the quality of the proponent's EIS, impact prediction methodology, projected impacts and mitigative measures. BSA also questioned the scope and mandate of the hearing process and government management capabilities. A

TABLE 8 GENERAL OVERVIEW OF COMMENTS BY NATIVE ORGANIZATIONS AND AFFILIATES

Dene Nation and Affiliates	
Inuvik (Dene Delta Regional Council)	- want partnership in development - changes too fast - life-style changes cause problems - recommend small buried pipeline - land claims before development - need balance between traditional life-style and development - community data indicate Dene want development
Yellowknife	- extensive discussion of Norman Wells Project impacts - many Dene depend on land resources - land claims
Labrador Inuit Association	
Resolute	- example offered of Melville ice breaking tests - query how to clean up winter oil spills - query on width ship corridors
Ottawa	- what forum open to Labrador Inuit Association to manifest concerns
Inuit Tapirisat	
Resolute	- difficulties faced by native people in terms of participation due to language and cultural barriers - need for joint ventures between developers and Inuit - query compensation for oil spills - query clean up of oil spills - query staffing/training requirements for ice breaking tankers - query alternative solutions if ice breaker fails trials - pointed out weakness of risk analysis
Ottawa	- basic concern about Inuit obtaining a role in wildlife management
Baffin Region Inuit Association	
Resolute	- queried noise effect on whales - queried effects of ship tracks - need to test crossing tanker ice track in Lancaster Sound - need information on long-term impacts on wildlife - provided information on wildlife harvesting study - Inuit oppose proposal - need for more studies - queried oil spill clean up feasibility - potentials for damage to wildlife - queried training, employment opportunities on IBTs - IBTs could be destroyed in severe winter weather, lost in whiteouts in spring

TABLE 8 GENERAL OVERVIEW OF COMMENTS BY NATIVE ORGANIZATIONS AND AFFILIATES (Cont'd)

Baffin Region Inuit Association (Cont'd)	
Resolute (Cont'd)	- pointed out there is a variation between ice conditions in western arctic and Lancaster Sound
Frobisher	- queried Proponents' position on land claims - queried how proponents proposed to avoid disturbing beluga, narwhal in migration and overwintering areas - there is a limited and poor use of Inuit knowledge
Ottawa	- pointed out lack of research on northern communities

general overview of the concerns expressed by BSA at the EIS hearings is provided in Table 9.

TABLE 9 GENERAL OVERVIEW OF COMMENTS BY INTEREST GROUPS

Beaufort Sea Alliance	
Inuvik	- land claims vulnerable to development - queried Proponents' mitigative measures - commented on poor quality of Proponents' EIS - commented on inadequate detail in EIS environmental assessment
Whitehorse	- need for North Slope protection - need for full Yukon participation in Beaufort development - small scale pipeline economically and ecologically sound - queried Proponents' mitigative measures - concern about caribou - cumulative, synergistic impacts should be examined - queried wildlife management capabilities - local users should be involved in caribou monitoring
Yellowknife	- discussed relationship between project-scale and impacts
Ottawa	- concern about government management capabilities - discussed management needs Stokes Point, Dempster Highway - queried single office as against single window management - raised question re lack of DIAND development policy - environmental accidents have led to mistrust

Municipal Governments and Local Businesses

The focus of this group's comments was concerns regarding community impacts, general amenity and infrastructure needs, social effects, local education, training and business opportunities associated with Beaufort Sea development and local control and involvement in managing and coordinating such development. Representatives of this group participated at both technical and community hearings in their home communities. Selected comments presented at the EIS hearings by members of this group are summarized in Table 10.

TABLE 10 SELECTED COMMENTS BY MUNICIPAL GOVERNMENTS AND LOCAL BUSINESSES

Town of Inuvik	- want industrial workers people to live in Inuvik, taxes - should have meaningful role in decision-making - queried monitoring to be done by proponents
Inuvik Chamber of Commerce	- regulatory process should not interfere with business - support concept of Arctic College
Whitehorse Chamber of Commerce	- frustrated with repetitive nature of federal review system - development may be excluded for sake of preservation - support development that maximizes benefits, minimizes costs to the environment

The Panel Report as a Reflection of Public Input

The Panel recommended that only small scale phased production and transportation be authorized, commencing with a single, small diameter pipeline. They recommended that government approve the use of icebreaking oil tankers only if a research and preparation stage was completed by government and industry and only after a two tanker stage demonstration that environmental and socio-economic effects are within acceptable limits. The Panel divided its 83 recommendations among seven subject areas. Table 11 indicates the number of recommendations in each subject area and the corresponding number of public comments. Twenty-four Panel recommendations related to further research to identify critical baseline information, determine potential impacts and develop monitoring and mitigation programs. Eighteen of the 24 recommendations are contained in the section on the natural environment.

TABLE 11 PANEL RECOMMENDATIONS

Subject Areas	No. of Recommendations	No. of Public Comments
Oil Spills	7	131
Human Environment	15	835
Natural Environment	34	707
Government Management	24	586
EARP	2	40
Intervenor Funding	1	4
Compensation	1	50
Total	83	2 369

Table 12 provides a more extensive identification of the areas of public comment and specific subject areas and identifies the Panel recommendations in these areas. However, the Panel recommendations were not based solely on public comment. Scientists and administrators from the Department of Indian Affairs and Northern Development, Department of the Environment, Department of Fisheries and Oceans, Department of Transport and the territorial governments participated actively in the formal technical hearings, commenting orally and through written submissions on the EIS as a basis for environmental evaluation, planning and decision-making on Beaufort Sea hydrocarbon development.

Benefits and Costs of Public Participation

Although indications of Beaufort Sea EARP hearing costs are available, the broad range of intangible cultural, social and amenity values underlying the concerns voiced by community residents and native organizations at the hearings inhibits the use of benefit cost accounting procedures.

Direct expenditures by FEARO on the Beaufort Sea EARP amounted to $2.5 million. DIAND provided over $1 million in intervenor funding to public interest groups. Other costs of government participation in the process are estimated at $1 million. The proponents have estimated that industry's direct expenditures in the hearings exceeded $7 million.

Intervenor funding was provided to all four major groups of public participants in the Beaufort Sea EARP hearings and is detailed in Appendix 1. The largest portion went to native organizations, more than 40%, interest groups

TABLE 12 PANEL RECOMMENDATIONS IN RELATION TO SUBJECT AREAS OF PUBLIC COMMENT

	Community Residents	Mun. Govt. & Local Business	Native Groups	Interest Groups	Panel Rec. Number
Oil Spills					
General	33	7	17	4	28
Trajectory Modelling	3	-	1	-	3
Sensitivity Mapping	1	-	-	-	4
Clean-up Techniques	15	1	6	5	5,6,7
Dispersants	6	-	2	1	
Biological Effects	16	-	5	2	8
Research	3	-	2	1	
Human Environment					
General	10	6	4	6	9,10,79
SOCIAL EFFECTS					
General	17	10	14	18	
Community Development	4	3	16	3	
Life-styles & Traditions	14	2	23	10	
Alcohol Abuse	16	4	9	1	
Money Management	5	1	-	-	
Work Schedules	6	-	2	1	
Social Services	10	3	8	2	
REGIONAL POPULATION GROWTH MANAGEMENT					
General	-	-	-	1	
Potential Population Growth Rates	2	1	-	3	
Managing Construction Work Force	2	-	2	1	11
Expanded Rotational Employment	2	-	1	-	
Temporary Construction Camps	3	3	1	-	
Managing Transient Job Seekers	2	1	-	2	
Managing Community Growth	9	5	2	3	
New Communities	1	-	1	-	
Project Abandonment	1	4	2	2	13

TABLE 12 PANEL RECOMMENDATIONS IN RELATION TO SUBJECT AREAS OF PUBLIC COMMENT (Cont'd)

	Community Residents	Mun. Govt. & Local Business	Native Groups	Interest Groups	Panel Rec. Number
RESOURCE HARVESTING EFFECTS					
General	10	2	4	3	
Importance of Resource Harvesting	23	2	26	8	
Effects of Employment	2	1	2	2	
Pressures on Resources	6	2	5	5	
Resource Management	7	1	12	2	14
COMMUNITY SERVICES AND FACILITIES					
General	4	3	1	-	
Municipal Services & Infrastructure	11	7	6	-	
Housing	8	3	2	-	
Local Energy Requirements	-	-	1	-	
Sand & Gravel Resources	-	-	1	-	15
ECONOMIC EFFECTS					
General	14	-	13	-	
EDUCATION AND TRAINING					
General	2	1	12	-	
Education	16	4	8	1	
Training	29	8	18	-	
Facilities	12	2	5	1	16
EMPLOYMENT					
General	27	-	15	5	
Northern Involvement	18	3	12	2	19
Cross Cultural Training	7	-	-	-	17,18
Job Motivation and Progression	5	-	-	1	
Labour Force Estimation	-	-	-	1	
Recruitment Programs	9	-	-	-	12
Union Practices	7	-	1	-	
Employee Health & Safety	3	-	2	-	20
NORTHERN BUSINESS OPPORTUNITIES					
General	4	11	8	1	21
SOCIO-ECONOMIC IMPACT ASSESSMENT					
General	7	-	5	8	24

TABLE 12 PANEL RECOMMENDATIONS IN RELATION TO SUBJECT AREAS OF PUBLIC COMMENT (Cont'd)

	Community Residents	Mun. Govt. & Local Business	Native Groups	Interest Groups	Panel Rec. Number
Assessment Methodology	-	-	1	6	
Monitoring	1	-	-	-	32
Community Participation	1	1	-	1	31
Research	1	-	1	-	
<u>Natural Environment</u>					
General	5	2	21	8	65
PROPOSAL EFFECTS ON THE ENVIRONMENT					
General	5	3	3	16	
Changing Climate	-	-	-	-	
Artificial Islands	9	3	1	-	30
Subsea Production	1	-	-	-	49
PRODUCTION SYSTEMS					
General	-	-	-	7	
Discharge of Formation Water	-	-	-	-	26
Disposal of Drilling Wastes	1	-	-	-	
Hazardous & Toxic Chemicals	2	-	-	-	27
Pressure Testing Fluids	-	-	-	-	
Ballast and Bilge Water	-	-	-	-	
Monitoring Fate of Pollutant	-	-	-	1	29
Ocean Dredging	1	1	-	1	
Stabilization of Landfast Ice	1	-	-	-	
Onshore Production Facilities	1	-	-	-	
ARCTIC TANKERS					
General	14	2	21	10	22
Navigation	1	-	12	1	
Effect of Icebreaking					
General	15	-	4	1	31
Break-up & Freeze-up	12	-	1	1	
Human Travel and Safety	20	-	2	1	32
Wildlife	15	1	2	2	
Effects of Vessel Sound					

TABLE 12 PANEL RECOMMENDATIONS IN RELATION TO SUBJECT AREAS OF PUBLIC COMMENT (Cont'd)

	Community Residents	Mun. Govt. & Local Business	Native Groups	Interest Groups	Panel Rec. Number
Marine Support & Regulation	4	-	3	1	33,34,59
Research & Preparation Stage	6	-	3	-	
Two Tanker Stage	11	-	-	1	
PIPELINES					
General	20	2	9	2	
Gas	-	-	-	-	
Small Diameter Oil	-	-	1	4	23
Large Diameter Oil	-	1	2	3	
Construction Phase Effects	-	-	-	-	
Operation Phase Effects	-	-	-	-	
Corridors	-	-	1	2	
Rights-of-Way	2	1	6	3	
SUPPORT FACILITIES					
General	2	1	1	2	25,50,51
Ports & Supply Bases	4	1	1	12	72
Supply Operations	-	-	-	1	
Quarries	-	-	-	8	52,53
Roads	-	1	1	7	
OFFSHORE BIOLOGICAL EFFECTS					
General	10	3	10	6	
Polar Bears	12	-	4	1	35
Seals	20	-	8	1	36
Whales	13	-	3	3	37,38
Walrus	4	-	5	-	39
Fish	8	-	2	-	40
Marine Birds	6	-	1	1	41
Benthic etc. Organisms	4	-	3	1	
Polynyas	-	-	2	-	42
Effects of Vessel Sound	23	-	13	5	44,46,47,48
ONSHORE BIOLOGICAL EFFECTS					
General	5	5	4	9	
Caribou	5	-	1	7	43

TABLE 12 PANEL RECOMMENDATIONS IN RELATION TO SUBJECT AREAS OF PUBLIC COMMENT (Cont'd)

	Community Residents	Mun. Govt. & Local Business	Native Groups	Interest Groups	Panel Rec. Number
Fish	8	-	3	2	
Birds	5	-	-	1	
Habitat Inventory	1	-	1	1	45
ENVIRONMENTAL IMPACT ASSESSMENT					
General	-	3	9	18	
Assessment Methodology	-	1	1	5	
Monitoring	1	1	2	2	
Research					
General	4	1	8	2	
Oceanographic	-	-	20	-	
Oil-Marine Mammals	3	-	-	-	
Oil-Terrestrial Mammals	-	-	-	-	
Marine Mammals	3	-	-	-	
Marine Mammal Habitat	3	-	-	-	
Fish	2	-	1	-	
Fish Habitat	2	-	-	-	
Birds	4	-	1	-	
Bird Habitat	-	-	-	-	
Terrestrial Mammals	-	-	-	-	
Terrestrial Mammals Habitat	-	-	-	-	
Integrated/Interdisciplinary	-	-	-	-	
Compensation					
General	24	1	28	3	56
Government Management					
General	14	21	37	35	63
Local Control	17	17	49	18	57,58,59
Project Coordination	5	15	19	11	54,55
Planning	8	3	11	17	62
Government Contingency Plans	6	-	3	1	64
Vessel Traffic Management	2	1	6	-	67,68

TABLE 12 PANEL RECOMMENDATIONS IN RELATION TO SUBJECT AREAS OF PUBLIC COMMENT (Cont'd)

	Community Residents	Mun. Govt. & Local Business	Native Groups	Interest Groups	Panel Rec. Number
Port Authorities	1	-	2	-	70,71
Impact Funding	10	2	9	4	73
Revenue Sharing	8	4	13	-	
Government Research	5	1	18	3	60
Monitoring	8	2	23	1	74
Surveillance	4	2	6	1	61,75
Archeological Resources	-	-	2	-	76,77
Technical Expertise	1	-	4	1	78
Other Developments	4	-	11	2	
Further Public Reviews	4	-	15	14	80
Aboriginal Claims	17	2	41	18	81
International Considerations	4	-	7	3	66,82
EARP					
General	4	2	3	7	
Operational Procedures	2	1	5	7	
Public Sessions	5	2	1	-	
Government Participation	-	-	-	-	
Technical Specialists	-	-	1	-	
Public Files/Information	-	-	-	-	2,83
Intervenor Funding	1	1	2	-	

Because of the general nature of many Panel recommendations, each recommendation has been related to a subject area on the basis of what appears to be the primary concern of the recommendation.

Figures listed under each group of public participants represent the total number of comments provided by the group during the EIS hearings in each of the identified subject areas.

received nearly 30% and municipal governments and local businesses and community residents each received almost 15% of the intervenor funding.

Post Assessment/Post Audit

Post-hearing information indicates the Panel report was well received by the Beaufort Sea-Mackenzie Delta area communities as a reflection of their participation in the process (Beaufort-Mackenzie Delta Development Impact Zone Society, 1984). The communities agreed with the Panel recommendations on small scale production and pipeline transportation mode. Communities reiterated a need for environmental impact controls and monitoring and addressed socio-economic aspects in the context of local training and employment needs, infrastructure needs, improvement in social programs and lower energy costs.

In the post-hearing period environmental groups have criticized the review process, in terms of advancing environmental assessment processes as a basis for decision-making on northern development (Canadian Arctic Resources Committee, 1984). Staff of the Dene Nation have joined environmental interest groups in public criticism of the Panel report on the basis of the Panel having not listened closely to the concerns expressed by community residents (Dene Nation, 1984). The pro-development municipal government and local business group has continued to support hydrocarbon development in the Beaufort Sea region.

Communities and the recently established Development Impact Zone societies in the Beaufort-Mackenzie Delta and Mackenzie Valley are becoming increasingly involved in government sponsored programs to prepare for monitoring the environmental effects of hydrocarbon production.

Conclusion

Rees (1983) has suggested that:

> "In the context of EIA...many potentially significant ecological impacts of development are simply unknowable before they occur. ...(This means) that the most probable useful contribution of the BSEARP will be in the identification of major knowledge gaps respecting Arctic development, in the articulation of public concerns and in exposing government management capability to public scrutiny, rather than in the identification of specific environmental effects."

Public input to the Beaufort Sea EARP focussed on an articulation of specific concerns about the proponent's development proposals and an identification of critical knowledge gaps in the proponent's EIS. Public participation provided additional data important in planning future specific development projects, identified local priorities, and indicated a desire for greater involvement in planning and managing development to optimize benefits and minimize potential impacts.

Over the course of time, EARP has advanced as an advisory review process on northern hydrocarbon proposals both institutionally and procedurally. The independent Beaufort Sea EA Panel, with its substantial northern representation, gave increased credibility to the review. As noted earlier, public participation procedures were both extensive and elaborate.

Given the diversity of interest groups, communities and the geographic scope of the review, it was to be expected that public reaction to the public participation procedures varied and was often interwoven with reactions to the overall process.[3] Public interest groups and government representatives felt the Calgary seminar did not produce the "scoping" results intended by FEARO. All of the public interest groups supported intervention funding as critical to their being able to participate. They criticized both the funding levels and delivery of funds during the extended review process. The Draft EIS Guideline hearings confused some residents of northern communities as to the intent and purpose of such hearings, given earlier hearings on similar development proposals and the planned EIS hearings. Other participants, such as the Labrador Inuit Association, the Dene Delta Regional Council and the Beaufort Sea Research Coalition, felt the Draft EIS Guideline hearings were helpful. The Yukon Conservation Society felt the operational procedures, while good in theory, were inconsistently applied during the hearings. Public interest groups as a whole were somewhat confused as to the role of the technical experts at the hearings and would have liked pre-hearing contact with the experts. Northern communities benefited from pre-hearing meetings with the Panel, workshops and zonal summaries. Translation services were an essential public participation procedure in northern centres. The public participation procedures, both standard and innovative, employed in the Beaufort Sea EARP provide a basis for planning future northern public review/consultation processes to meet public interests and concerns.

The public comments to the Beaufort Sea EARP Panel clearly indicate that the northern public is becoming increasingly sophisticated in defining terms and conditions for development, in the context of information contained in the proponent's EIS, and the need for impact control and mitigation. Community residents provided the greatest public input to the Panel, expressing concerns about all facets of the proponent's EIS and development scenarios and generally supporting small-scale pipeline development for initial Beaufort Sea development. Native organizations accounted for almost as many of the recorded comments to the Panel as community residents. They reiterated the need for a land claims settlement before development proceeds and focussed their comments on concerns about access of native people to development related business and employment opportunities, environmental implications of year-round arctic tankers and partnership in the planning and management of development. Interest groups provided substantial criticism of the environmental impact assessment procedures and the EIS as well as raising issues that were beyond the Panel's mandate to consider. Municipal governments and local businesses supported small-scale phased development such that northern employment and business opportunities were optimized.

FOOTNOTES

1. Six types of information were identified as the possible basis for reviewing the transcripts and written submissions for the Beaufort Sea EARP, including:

    1. New information - which added to the information base (local knowledge and scientific data).

    2. Additional information needed - identification of specific information which participants deemed necessary (additional research, more up-to-date data; etc.).

    3. Disagree with information - participants with information provided in the EIS or information orally provided by industry representatives at the hearings.

    4. Agree with information - expression of general agreement with information as presented.

    5. Concerns - participants expressed specific concerns about an extensive range of items such as oil spills, pollution, environmental or social economic impacts, timing of development.

    6. Information outside the Panel's mandate - matters not pertinent to, or beyond the mandate of the Beaufort Sea EARP Panel were not considered in the tabulation, except for those comments on such matters as land use planning and aboriginal claims.

2. The tabulations summarized in Tables 4 and 5 were submitted to Chi Square tests. The resulting values (36.00 for Table 4 and 127980.91 for Table 5) indicated a further review of the data should look at percentages and apparent trends extrapolated from the data.

3. Of the native organizations who participated in the review, to date only the Dene Nation has commented on the Beaufort Sea EARP. The Dene Nation Beaufort Sea Evaluation Project report commented favourably on the availability of intervenor funding, but criticized the level of funding. It supported the Draft EIS Guideline hearings as providing an opportunity to input planning the ground rules for the hearings, and clarification of the scope, goals and objectives of the hearings. The report indicated that the operational procedures were inconsistently applied during the hearings. The report indicated that as participants, Dene Nation representatives felt that the role of the Panel's technical experts was unclear and insufficient contact occurred between participants and the technical experts prior to the hearings which hampered effective utilization. They also expressed a view that the non-confrontational procedures of the panel inhibited clarification of some issues during the hearing process.

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APPENDIX 1 INTERVENOR FUNDING PROVIDED TO PARTICIPANTS IN THE BEAUFORT SEA EARP HEARINGS

	1981-2	1982-3	1983-4	TOTAL
Communities				
Aklavik	-	30 000	-	30 000
Arctic Bay	2 000	6 000	-	8 000
Beaufort Hunters and Trappers	-	-	2 500	2 500
Fort Good Hope	-	6 000	-	6 000
Fort McPherson	-	8 000	-	8 000
Fort Norman	-	2 500	-	2 500
Fort Simpson	-	6 930	-	6 930
Holman	-	7 000	-	7 000
Hopedale	-	-	2 500	2 500
Makkovik	-	-	2 500	2 500
Nain	-	-	7 000	7 000
Norman Wells	-	7 000	-	7 000
Old Crow	1 500	6 000	-	7 500
Paulatuk	-	2 500	-	2 500
Pond Inlet	1 000	10 000	-	11 000
Postville	-	-	2 500	2 500
Rigolet	-	-	2 500	2 500
Sachs Harbour	-	5 000	-	5 000
Tuktoyaktuk	4 000	12 000	-	16 000
Municipal Governments and Local Businesses				
Beaufort Sea Advisory Committee	20 000	20 000	-	40 000
Canada Reindeer	-	7 500	-	7 500
Inuvik	28 000	60 000	-	88 000
Inuvik Chamber of Commerce	-	7 500	-	7 500
Native Organizations				
Baffin Region Inuit Association	-	40 000	9 094	49 094
Council for Yukon Indians	6 500	10 000	-	16 500
Dene Nation	59 000	50 000	26 912	135 912
Inuit Tapirisat of Canada	23 000	75 000	2 981	100 981
Labrador Inuit Association	-	20 000	5 774	25 774
Metis Association of the NWT	36 000	70 000	-	106 000
Interest Groups				
Beaufort Sea Alliance/Research Coalition	134 000	100 000	55 000	289 000
National and Provincial Parks Association	-	1 500	-	1 500
TOTAL	$ 315 000	$ 570 430	$ 119 261	$1 004 691

APPENDIX 2 DRAFT EIS GUIDELINE HEARINGS SCHEDULE

Community Sessions	
Aklavik*	November 4, 1981
Sachs Harbour*	November 5, 1981
Fort Norman	November 17, 1981
Tuktoyaktuk	November 18, 1981
Inuvik	November 19, 1981
Pond Inlet*	December 1, 1981
Pangnirtung*	December 3, 1981

Technical Sessions	
Inuvik	November 20, 1981
Whitehorse	November 23, 1981
Yellowknife	November 25, 1981
Calgary	November 26 and 27, 1981
Pond Inlet	December 1, 1981
Pangnirtung	December 4, 1981

* Transcript not prepared.

APPENDIX 3 EIS HEARINGS SCHEDULE

Pre-Session Conference	
Yellowknife	September 13, 1983

Community Sessions	
Tuktoyaktuk	September 14, 1983
Aklavik	September 15, 1983
Sachs Harbour	September 16, 1983
Holman Island	September 17, 1983
Coppermine	September 19, 1983
Paulatuk	September 20, 1983
Fort McPherson	September 21, 1983
Fort Franklin	September 23, 1983
Norman Wells	September 26, 1983
Fort Good Hope	September 27, 1983
Fort Norman	September 28, 1983
Fort Simpson	September 29, 1983
Pond Inlet	October 13, 1983
Arctic Bay	October 14, 1983
Resolute	October 18, 1983
Pangnirtung	October 22, 1983
Frobisher Bay	October 24, 1983
Nain	October 26, 27, 1983
Old Crow	November 11, 1983
Inuvik	November 22, 1983

General Sessions	
Resolute	October 15, 17, 18, 19, 20, 21, 1983
Inuvik	November 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 21, 22, 23, 24, 1983
Whitehorse	December 1, 2, 3, 1983
Yellowknife	December 5, 6, 7, 8, 9, 1983
Calgary	December 12, 1983
Ottawa	December 14, 15, 16, 1983

REGIONAL PUBLIC INVOLVEMENT IN THE BEAUFORT SEA ENVIRONMENTAL ASSESSMENT REVIEW PROCESS

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Introduction

In 1980, a proposal to produce and transport oil and gas from the Beaufort Sea was referred for public review under the federal Environmental Assessment Review Process (EARP). The proposal described the likely directions oil development could take in the region and was developed by the three most active oil companies - Dome Petroleum Limited, Esso Resources Canada Limited and Gulf Canada Resources Inc.

The development options before the Beaufort Sea Environmental Assessment (EA) Panel ranged from a relatively low level of production and a small diameter pipeline to a high level of production and a large diameter pipeline and/or oil tankers. While the production activities would be centered in the Beaufort Sea area, the transportation alternatives would extend much farther. Communities in the Mackenzie Delta area, the Eastern Arctic, Labrador and throughout the Mackenzie Valley could be affected. It was also considered that some residents in Alaska and Greenland might be affected. Other public groups, based in southern Canada and the Yukon and concerned with national energy policies and/or the northern environment, also felt a need to participate in the review.

The importance of public participation was established in the Panel's terms of reference and was reiterated throughout the review. This paper describes and reviews the involvement of the residents of the Beaufort Sea communities in the Panel's review (see Figure 1).

There were many opportunities for the public to be involved in the Beaufort Sea review and the actual participation took many forms. The public involvement programs associated with past EARP reviews were augmented in a number of ways for the Beaufort review. These included an "Issues" workshop before the Panel had been appointed, public meetings on the Draft Guidelines for the Preparation of the Environmental Impact Statement (EIS), the provision of intervenor funding, and a round of consultations after the release of the Panel report (Tables 1 and 2).

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1 The opinions expressed in this paper are those of the author and do not necessarily reflect the views of the GNWT.

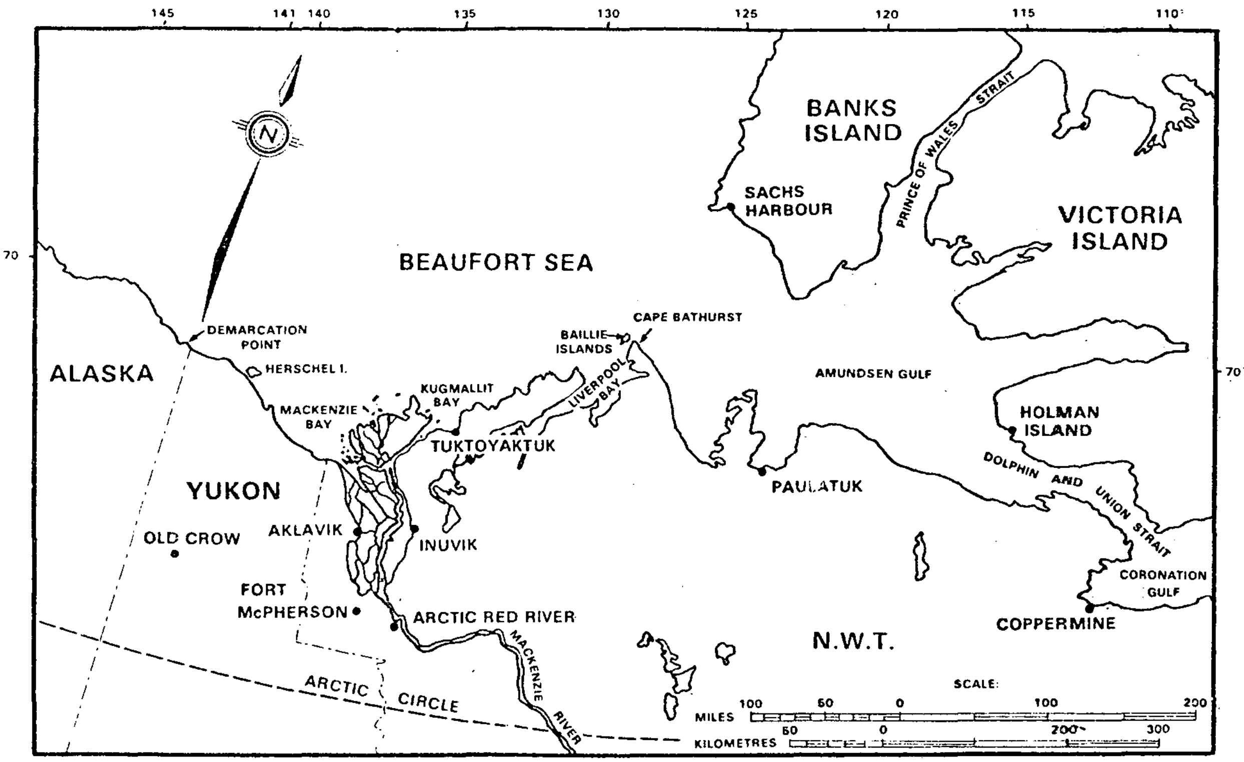

FIGURE 1 THE REGIONAL SETTING: BEAUFORT SEA COMMUNITIES

Public Involvement Activities

EIS Preparation

The importance of northerners' input to the EIS was stressed in the guidelines for it's preparation. After the EIS was released, all participants in the review were invited to submit comments on the documents to the Panel.

Industry in the Beaufort has been successful in establishing a local presence and in demonstrating an awareness of and sensitivity to local issues and concerns. There was not, however, a systematic attempt to gather information from the community residents as part of the preparation of the EIS. In the EIS (Volume 5 1.3) it was pointed out that, in fact, industry "can only go so far in attempting to reflect regional and community concerns and positions in a document that it prepares as the proponent of a major industrial development program. It is up to the Industry to state its position, but up to the people that development will affect to state theirs".

TABLE 1 FORMAL OPPORTUNITIES FOR PUBLIC INVOLVEMENT IN THE BEAUFORT SEA ENVIRONMENTAL ASSESSMENT REVIEW

Issues Workshop
November, 1980
Calgary

Many community, government and industry representatives attend an invitational workshop to discuss anticipated issues.

Guideline Hearings
Fall, 1981
Regional Centres

Regional hearings are held to receive comments on the EIS Guidelines.

Preparation and Review of the Environmental Impact Statement 1981 and 1982

The Guidelines required the involvement of northerners in the preparation of the EIS. All participants in the review were invited to identify any EIS deficiencies for the Panel.

EIS Hearings
Fall 1982
All Beaufort Mackenzie/Delta communities (and other communities)

Community members attended and participated in the community and general sessions.

Review of the Panel Report
Fall 1984
Regional Centres

Community organizations comment on the Panel report and recommendations.

Local Staff

The Federal Environmental Assessment Review Office (FEARO) which provided secretariat support to the independent Panel, opened a regional office in Inuvik early in the review process. Roger Gruben, a local resident, was hired by

TABLE 2 INTERVENOR FUNDING FOR THE BEAUFORT SEA AND MACKENZIE DELTA COMMUNITIES

Organization from Intervenor Fund	Funds
Town of Inuvik	88 000
Tuktoyaktuk	16 000
Aklavik	30 000
Fort McPherson	8 000
Paulatuk	2 500
Holman	7 000
Sachs Harbour HTA	5 000
NWT Metis Association	106 000
Dene Nation	114 000
Beaufort Sea Community Advisory	40 000
Inuvik Chamber of Commerce	7 500

Some intervenors were able to access funding from other sources. For example, Dome funded the Beaufort Sea Community Advisory Committee; DIAND funded the Mackenzie-Delta Dene Regional Council; the GNWT funded the Regional Hunters' and Trappers' Association and FEARO assisted in funding several regional workshops.

FEARO and functioned as an active liaison between regional communities and the agency. He participated in many community meetings prior to the public hearings.

Many communities and organizations implemented short-term field-worker programs. Field-workers, who were community residents, assisted in the preparation of community presentations for the public hearings and served as a local information source for the EARP process. Some community intervenors also used "outside" expertise to assist them with their information programs and presentation materials.

Community Presentations

The most widely used method for information distribution and provision of feedback was to provide brief information presentations at community meetings. The community council, the band council and the hunters' and trappers' association were the usual groups for these discussions. These presentations were initiated by FEARO staff, industry representatives and intervenors. In most cases, the presentations served to provide information to community residents or organizations about the EIS and the review process.

Industry representatives documented for the Panel, their EIS information presentations and attendance at other community meetings during the course of the review. Regional groups, in particular the Mackenzie Delta Dene Regional Council and the Beaufort Sea Community Advisory Committee, became increasingly active during the course of the review.

Attempts to systematically obtain information from community residents were more infrequent than the public information meetings. Local phone-in radio programs were used in some communities to gather concerns. In Paulatuk, community residents were surveyed with a questionnaire and the results were presented in the community council submission to the Panel.

Special Workshops

Structured workshops were sponsored by many organizations. FEARO, the Beaufort Sea Community Advisory Council and the Mackenzie Delta Dene Regional Council organized workshops with invited community delegates. Numerous resource persons attended these sessions, including technical advisors to the Panel, independent consultants, industry and government representatives. At these workshops, community representatives were provided with information about the industry proposals and the EARP review, and were assisted in their preparation for the public hearings (Table 3).

TABLE 3 WORKSHOPS HELD WITH BEAUFORT SEA COMMUNITY ADVISORY COMMITTEE FIELD-WORKERS

Date	Workshop Focus
March 1982	*overall orientation to EARP process *consideration of options and methods for community involvement
April 1982	*planning for community-based activities
July 1982	*community survey methods
December 1982	*meeting with Panel technical advisors *EIS review

Publications

Extensive written material was published and distributed throughout the review. Every community in the region received copies of the entire 7 volume set of the Environmental Impact Statement (EIS) and the 2 volume Deficiency Response. Special "community" editions of the EIS - summaries of the complete document - were produced and distributed by the proponent towards the end of the review.

In addition to the industry material, government departments and agencies distributed their intervention submissions throughout the region. Some intervenors also produced written material for community distribution. The Beaufort Sea Alliance published a community newsletter.

Participation of Community Residents in the Public Hearings

Tables 4, 5 and 6 document some of the actual participation by Beaufort community members in the public hearings on the EIS.

TABLE 4 COMMUNITY PARTICIPATION IN BEAUFORT REGION COMMUNITY HEARINGS

The Panel and associated staff were 20-25 persons and are excluded from the following estimates.

Community	Number of community members in attendance at the community hearing (approximately)	Community population (1983)
Aklavik	20	750
Tuktoyaktuk	15	833
Fort McPherson	50	658
Arctic Red River		118
Paulatuk	25	188
Holman	15	335
Coppermine	25	849
Sachs Harbour	15	161
Inuvik	40	3617

TABLE 5 PRESENTATIONS AT COMMUNITY HEARINGS

Fort McPherson, Arctic Red River

Name of presenter	Background, occupation	Formally representing
J. Charlie	Chief, Band Council	
C. Koe	Elder	
N. Norbert		
H. Andre	Trapper	
E. Firth		
R. Simpson	Band manager	Dene Regional Council
C. Snowshoe	Vice-Pres., Dene Nation	
W. Macdonald	Elder	

Aklavik

Name of presenter	Background, occupation	Formally representing
M. Carrol	NCPC employee	
F. Greenland	Chief, Band Council	
J. Dixon	Anglican clergy	
S. Gardlund	Elder	
G. Edwards	Alcohol counsellor	
J.E. Sittichinli	Elder	
L. Sittichinli	Elder	
C. Furlong	Band Manager	

Paulatuk

Name of presenter	Background, occupation	Formally representing
G. Ruben	Contractor	
E. Ruben	COPE	
R. Ruben	Hunter	
T. Thrasher	Hunter	
G. Ruben	Hamlet staff	Paulatuk Council

Coppermine

Name of presenter	Background, occupation	Formally representing
T. Pigalak	Hunter	
E. Bernhardt	GNWT, Social Services	
D. Havioyak	GNWT	
A. Algiak		

TABLE 5 PRESENTATIONS AT COMMUNITY HEARINGS (Cont'd)

Holman Island

Name of presenter	Background, occupation	Formally representing
R. Kuneyuna	Hunter	Hunters' & Trappers' Assn.
A. Simms	Transport Canada	
I. Aleekuk	Hunter	
A. Elias	Contractor	
J. Rose		
S. Kataoyak	Hunter	
R. Kuptana	COPE	

Sachs Harbour

Name of presenter	Background, occupation	Formally representing
P. Esau	Hunter	
S. Esau	Homemaker	
A. Carpenter	Hunter	
R. Goose	Consultant	Hunters' & Trappers' Assn.
R. Kuptana	Hunter	
F. Sidney	Contractor	
F. Carpenter	Elder	
C. Haogak	COPE	

Tuktoyaktuk

Name of presenter	Background, occupation	Formally representing
R. Goose	Consultant	Hunters' & Trappers' Assn.
E. Dillon		Tuktoyaktuk Council
E. Kiklwa	Self-employed	
A. White	Visiting, former resident	
M. Lyons	Teacher	
C. Pokiak		
A. Carpenter	Homemaker	

TABLE 5 PRESENTATIONS AT COMMUNITY HEARINGS (Cont'd)

Inuvik

Name of presenter	Background, occupation	Formally representing
D. Currie	Teacher	
B. Cody		Inuvik Ski Club
B. Weir	Coordinator	Council for the Disabled
E. Cardinal	Student	Native Women's Assn.
K. Schneider	Clergy	
S. Huskey		
Dr. Heine	Physician	
B. Allen	President	Native Women's Assn.
S. Burlingame	Educator	
J. McEachern	Gulf	
A. Pluim	Businessman	
D. Kisoun	COPE	
J. Hicks	Dene Nation	
P. Westaway	Director, Ingamo Hall	
L. Wark	Businessman	
E. Loüis		
D. Billingsley	Businessman	
T. Zubko	Businessman	
V. Boudreau	Travel agent	
C. Hill	GNWT, Education	

Note: Background and occupation are provided for identification purposes.

TABLE 6 PARTICIPATION OF COMMUNITY ORGANIZATIONS IN THE INUVIK GENERAL (TECHNICAL) SESSION

Name of presenter	Oganization represented
J. Robertson	Town of Inuvik
D. Hill	Chamber of Commerce
F. Greenland & J. Andre	Beaufort-Mackenzie Delta Development Impact Zone
L. Dillon, L. Cockney & R. Mangeluna	Tuktoyaktuk Social Services Committee
J. Knox	Beau-Tuk Marine Services
B. Knox	McDonald's Electric
--	Mackenzie-Delta Dene Regional Council

1. Community representation. From a review of the persons involved in presentations at the hearing in their community, it is obvious that a

representative cross section of the communities did not participate in the community meeting. During the year of the hearings, several hundred Beaufort community residents were employed directly with the 3 major oil companies and even more residents were benefitting through indirect employment because of business contracts. Yet very few business people made the effort to speak to the Panel. In addition, few women or young people made presentations at their community meeting. Community presentations should remain an important source of information about community concerns for the EA Panels, who would be well-advised to consider the use of additional methods to ensure an adequate representation of the diverse perspectives present in even small traditional northern communities.

2. Prepared presentations and group representations. Despite the effort and resources dedicated to intervenor assistance, few interventions were written and prepared in advance of the community meeting and few presenters were actually formally representing a community group. The formal written submissions tended to be more useful documents, focussing on concerns and recommendations that would influence the Panel's deliberations. For many northern communities, community hearings are still seen to be an exercise involving individual presentations rather than a careful analysis and presentation of community priorities. This attitude is perhaps reinforced by the "one-time" nature of a "special" meeting with well-meaning "out-of-town" experts and their cast of staff and southern media.

3. The use of opportunities for public involvement. For the most part, the efforts made to assist the community interventions emphasized participation in the community hearings on the review of the EIS. Few Beaufort communities made well-organized submissions at the EIS Guidelines review - although Inuvik was a notable exception. Most Beaufort intervenors did not submit an EIS review or deficiency recommendations to the Panel. Some community-based organizations did choose to appear at the technical sessions in Inuvik. For example, the Mackenzie-Delta Dene Regional Council and the Tuktoyaktuk Social Services Advisory Committee presented their submissions at that location. The community groups acted as presenters and not as full intervenors. They seldom participated in more than one session or asked questions or gave opening and closing statements. If public involvement is to be strengthened, then the direction should be to change the process until it

more appropriately responds to community interests and concerns, rather than trying to fit community participation into the already established procedures.

Challenges

In the Beaufort Sea review process, an attempt was made to foster effective, sustained public involvement. A number of factors relating to the nature of the proposal, the communities involved, and the review process itself, made this objective difficult to achieve.

1. The Proposal. At the time of the referral to EARP, no site-specific plans had been submitted. The proposal under review was not a specific plan but a discussion of general concepts for Beaufort development. Reviewing such a proposal proved to be a difficult task for the best of reviewers and a formidable task for community members.
   It was a significant challenge, then, to produce information which was both brief and meaningful to lay readers and technically acceptable. The conceptual level of the proposal may also have served to discourage public involvement. Lang and Armour (1980, 302) have noted: "A given project affecting a specific site is more likely to attract people, whose interests are thereby directly engaged, than an area-wide or regional plan".

2. The communities. The communities in the Beaufort region are spread out over a large area and, except for Inuvik, are small, with populations of approximately 100 to 800.
   Public reviews conducted in southern Canada can assume the existence of skilled public interest groups. Public reviews in northern communities need to contend with isolated and traditional communities that, for the most part, do not have the local capacity to undertake a highly technical review.

3. The review process. The main opportunity for public involvement in EARP is the review of the EIS, especially at the public hearings. For the Beaufort review, it was difficult to sustain public interest in a four year process with two rounds of public hearings. Some organizations were enthusiastic participants during the first round of hearings and had lost interest before the final round of hearings. The Town of Inuvik is an example. The intervenor funding

program ran out of funds almost a year before the final public hearings. Many intervenors had not planned for a multi-year effort.

EARP is a federal process. The Government of the Northwest Territories has the status of an intervenor. Where control over a review process is held by a geographically distant authority, the extent of local participation may be less than in more locally controlled reviews.

Perhaps the most critical feature of the review is the relationship of the review to actual decision-making. Where communities cannot see visible and direct benefits resulting from their participation, significant public involvement will be difficult to obtain. In the Beaufort region, as elsewhere, there has been considerable experience with, and cynicism about, external agencies consulting with the northern public without any observable effect.

Conclusions and Recommendations

The complexity of the proposal under review and thus its potential biophysical and social impacts, along with the complexity of the northern social environment, presented considerable challenges to those attempting to involve regional residents in the Beaufort Sea review.

Grima (1985, 39) contends that there has been "very little empirical work on the effectiveness of the various techniques of public involvement" in the environmental assessment process. A number of suggestions emerge from the experience of the Beaufort Sea review regarding public involvement in the north.

1. The limited responsibilities and resources presently assigned to the affected communities need to be re-examined. At the least, the role of the public needs to be realistically defined at the outset of any review. The timing and extent of the opportunities for participation, the resources available to make use of these opportunities, and the relation of the outcome of the review to the decision-making process are crucial elements of this definition.

2. If public involvement is considered to be a significant component of the review process, then greater emphasis should be placed on the community-oriented publications.

   The EIS, the review process and the various government statements might have been more accessible to community members if materials aimed at community users had been distributed early in the review.

3. Public involvement requires the use of specialized skills and methods. Granting funds to community-based organizations did not necessarily result in an organized intervention.

   The representation of community issues needs to remain the community's responsibility and yet requires the resources and expertise accorded to other development issues. Most public involvement programs associated with environmental assessments consist of providing information to communities and then an opportunity to come before the review panel or board. The development and use of effective methods of public involvement has not been a high priority even among agencies with responsibilities in the Northwest Territories.

   The financial and other resources available because of the review strengthened the community presentations. In the Beaufort review, regional community groups appeared to benefit from workshops that were organized around a specific topic and were directed at selected community delegates rather than the general public. The use of consultants also appeared to assist in the preparation of Panel submissions.

   One example of this combination of local expertise and "outside" assistance is the submission prepared by the Paulatuk council. The Paulatuk field-worker attended workshops sponsored by the Beaufort Sea Community Advisory Committee and received assistance from the director of the Committee's program. The submission from Paulatuk was described as "...a totally perfect document..." (Nordicity Group Ltd., 1985, F-17).

4. The utility of public hearings as a mechanism to obtain representative information is questionable. Effort should be made to work with and strengthen ongoing local and regional mechanisms rather than continually have to attract and divert community attention to a process that produces yet another advisory report.

There is no magic formula to ensure effective public participation in environmental assessment processes. Public involvement needs to be undertaken as part of a well-planned and equipped program, tailored to the particular characteristics of the proposal, the public and the review process. Adequate documentation of any public involvement techniques used and an evaluation of their utility will assist the improvement of existing project review structures.

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THE LEPREAU II EIA: PUBLIC PARTICIPATION AND TECHNICAL EXAMINATION - BALANCING THE REQUIREMENTS

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Introduction

In recent years, the definition of environmental impacts has broadened considerably. It now extends well beyond bio-physical impacts to include those which affect the social and economic fabric of communities. In regard to both these areas, a successful EIA must achieve a balance between maintaining high standards in its examination of technical data, and ensuring that such information is publicly reviewed so that meaningful input from citizens can be incorporated in the final material presented to decision-makers.

It is clear from past experience in EIA administration that there can be inherent conflicts and a failure to meet these objectives, if one or the other is given undue weight. From the technical side, many scientists in bio-physical disciplines will take issue with the emphasis placed on public participation. Public interest groups and social scientists, by contrast, will increase demands for more opportunities through which citizens have access to decision-makers. For EIA administrators, keeping this balance can be a difficult task. The objective of this paper is to review the Lepreau II project experience, comment on the degree to which it "kept the balance", and offer some suggestions for future administration of such efforts.

Background on the Lepreau II Proposal

In early 1983, Atomic Energy of Canada Limited (AECL) and The New Brunswick Electric Power Commission joined in a consortium (Martime Nuclear) to study the feasibility of constructing a second nuclear power station at Point Lepreau, N.B. Since AECL and N.B. Power are both Crown Corporations, the Maritime Nuclear proposal was subject to screening under the respective federal and provincial environmental assessment review processes. In order to avoid duplication, it was decided to conduct a joint federal/provincial review, which would meet the needs of both jurisdictions.

The existing nuclear station at the site (Lepreau I) is owned and operated by

N.B. Power. It began commercial production in 1981, and meets roughly 1/3 of New Brunswick's annual power demand. In contrast, Lepreau II was conceived from the outset as a plant which would produce power for export sales only, at least in its first 20 years of operation. The development scenario called for U.S. utilities to bear the cost of construction and operation through long-term power purchases, while interim financing guarantees would come from the Government of Canada. The Province's role (through N.B. Power) would be to assist project development through construction and operational expertise, in return for some equity in the completed plant, once the initial investment had been recouped from U.S. sales.

Planning the Review

During the summer of 1983, a general framework for the federal/provincial EIA on Lepreau II was developed. For a number of reasons, including the "federal" character of the proposed project, this agreed framework followed quite closely the Federal Environmental Assessment and Review Process (EARP).

At this time, it had been several years since a new nuclear power station had been proposed anywhere in Canada. In the intervening years, well-publicized problems concerning the nuclear industry in the United States, such as Three-Mile Island, and equipment failures at nuclear facilities in Ontario, had led to an expansion of anti-nuclear opinion in Canada. This sentiment appeared to be most pronounced in central Canada. There was a perception in some quarters that the "nuclear safety debate" was likely to spill over into New Brunswick, with the Lepreau II EIA becoming a major forum for public debate on the issue.

Within New Brunswick, however, the public were less concerned with nuclear power than with socio-economic concerns. The construction of Lepreau I in the mid-1970's had been characterized by cost overruns, serious labour conflicts, and time delays which stretched over several years. Except for New Brunswick's relatively small anti-nuclear movement, public response to the Lepreau II proposal tended to stress "jobs for local residents" and greater economic spin-offs from such mega-projects.

The Lepreau II Review Chronology

On September 28, 1983, the Federal and New Brunswick Ministers of the Environment announced the joint federal/provincial review of the Lepreau II proposal. Roughly two months later, a four member Environmental Assessment Panel was appointed. During the next twelve months, a "public scoping" exercise was carried out; the Assessment Panel issued guidelines for preparation of an EIS; the proponent submitted an EIS to the Panel for review; the Panel asked for and received a supplementary report from the proponent addressing deficiencies in the initial statement; and, finally, the Panel held a two week series of public meetings on the collected documents. Once the meeting series was complete, the Panel began preparation of its report to Ministers. This was submitted and released on June 14th, 1985.

Lepreau II - An Administrative Challenge

Administration of the Lepreau II Review was a significant challenge for the federal and provincial agencies involved. As is often the case, time constraints were a factor, particularly as viewed by representatives from the proponent, and the two consortium partners. At the time the review was announced, spokesmen for Maritime Nuclear were suggesting publicly that, in order to have the project completed in time to secure the required sales contracts with U.S. utilities, construction would have to commence in the fall of 1984.

Working against this "proponent's view" of the schedule were several factors which had the potential to lengthen, rather than shorten the process. These included the usual logistical problems surrounding public reviews; the fact that the four federal/provincial Panel members lived thousands of miles apart (three of whom had other professional demands on their time); and the requirement that all public communication concerning the Review had to be carried out in both English and French. New Brunswick is Canada's only officially bilingual Province.

Introduction of New Procedures

In addition, two new operational procedures were introduced for the Lepreau II EIA, which had not been used previously in administration of EARP projects. Both ideas had grown out of recommendations contained in the study by Beanlands and Duinker (1983). The implementation of the Study Advisory Group concept was aimed at improving the technical side of the process, while "public scoping" and other efforts to provide public access to the process were introduced to improve the "public" component of the Review.

The Study Advisory Group (SAG) reported to the Panel Secretariat and included experts in the fields of radiation and health, ecology, marine biology and social sciences. It was established to assist the proponent in developing sound scientific methodologies for predicting the environmental impacts of the project. The SAG and the proponent met early in the process (before guidelines were established) to conceptually model the interactions between the project and the environment. SAG members also contributed to the scoping sessions in their own professional capacity by submitting written representations to the Panel on issues they identified as significant for consideration in the EIS.

The aim of public scoping was to solicit the opinions of the public on issues associated with the proposal, before the Panel established and issued guidelines to the proponent concerning preparation of the EIS. The scoping process included two separate types of public sessions: open houses, and workshops.

The open houses were day-long informal "storefront" operations conducted by the Panel Secretariat in communities near the existing nuclear plant. Information on the project was provided by the proponent, and staff supplied information on the environmental assessment process. A report on comments received from citizens who visited the open houses was subsequently prepared for the Panel's consideration. Two weeks later, the Panel itself conducted two one-day scoping workshops. These provided more formal opportunities for discussion of issues between the proponent, government agencies, and the public.

"Federal" Procedures in a Provincial Context

In addition to procedures which were "new" to EARP, some long-established EARP procedures were themselves significantly different from those which had been used in the Province since the mid-1970's. The most significant difference is the federal appointment of an independant panel to consider the EIS, hold public meetings, and make a final public report, with recommendations, to the responsible Minister(s). In New Brunswick, there is no provision for separate environmental assessment panels. An interdepartmental review committee involving representatives of various provincial, regional, municipal and federal agencies, provides technical input and advice throughout the review. Responsibility for making judgements on the significance of the EIS data, and the public's response to same, rests exclusively with the Minister of the Environment, and his or her Cabinet colleagues.

During the EIA process in New Brunswick, much emphasis is placed on assisting members of the public in becoming familiar with the EIS data, through a variety of information and consultation techniques which stress informality wherever possible. The meetings themselves are carried out with a minimum of procedural restrictions. Layman's summaries of the final EIS are prepared for public distribution by the Environment Department, which coordinates the review, rather than by the proponent, as in the federal process. These summary materials are very widely distributed as part of the EIS documentation before any public meetings take place.

In an EARP review, the process is centered on the functioning of a formal Panel, which must be seen at all times as "independant" of Government. To reinforce this image, it is seen as crucially important to conduct all Panel business in public. All written communications between the Panel, the proponent and any other participant in the review reside in a public file, and no meeting between the Panel and the proponent is possible, except in a public forum.

In the New Brunswick system, communication between the Environment Department, the interdepartmental review committee and the proponent takes place continuously throughout the review. Through this interaction, many issues of a technical nature are discussed and often resolved before the EIS is distributed publicly. Those issues which remain unresolved at the technical level are brought to the attention of the public during the public participation component of the review.

It is clear that the EARP approach to balancing requirements for technical assessment and public involvement differs from procedures traditionally used in New Brunswick. The analysis which follows is aimed at examining the impact of these differences, as well as the new procedures introduced, on the degree of success achieved during the Lepreau II "balancing act".

Terms of Reference

Detailed terms of reference for the Lepreau II review were established by the two Ministers as part of their initial announcement. These had been previously drafted through a consultative process involving the Federal Environmental Assessment Review Office (FEARO), the Federal Department of Energy, Mines and Resources, and Environment New Brunswick. It is our understanding that the Lepreau II Review was the first environmental assessment project at the federal level to begin with the announcement of final terms of reference by Ministers, excluding certain issues from consideration, before the independant Panel was itself appointed.

Since the proposal was for a nuclear power station built primarily for export sales, this approach was apparently directed at avoiding duplication with two other federal approval procedures which apply to such projects, administered by the National Energy Board and the Atomic Energy Control Board respectively. The Ministerial statement indicated that the Lepreau II Review should address only the environmental and directly-related social impacts of the project. Questions relating to energy exports and the role of nuclear power within Canada's national energy policy were specifically excluded from consideration.

Lepreau II - An Analysis of the Technical Examination

Guidelines

Guidelines are a key element in any environmental assessment process, since they usually serve as the mechanism for formally identifying study requirements. Unlike previous EARP environmental assessment reviews, draft guidelines for the Lepreau II EIS were not available for public comment prior to finalization and issuance of the proponent.

Under the new procedures established for this review, "public scoping" was introduced to identify broad issues, which could then be translated by the Panel into issue-oriented guidelines. The responsibility for designing specific environmental study methodology would then fall to the proponent and his consultants, with assistance provided by the Study Advisory Group.

The advantages of this approach are an ability to focus on those issues which are relevant to the decision-making process (i.e., issues of public concern), and flexibility to design appropriate scientific studies to predict impacts. This approach also dictates that the Panel must rely heavily on others to successfully translate issues into studies which will yield information on project impacts. In situations where members of the Panel are technically oriented themselves, however, the natural tendency is to take that all-important step and avoid uncertainty.

This was the case with the Lepreau II Panel. Three of its members, including the provincial Co-Chairman, were specialists in academic and technical fields (Nuclear Physics, Aquatic Biology and Social Sciences). The fourth Panel member, and federal Co-Chairman, was a senior member of the FEARO staff in Ottawa.

In the final analysis, the Guidelines produced by the Lepreau II Panel were more typical of the traditional approach to guideline writing, with heavy reliance on methodology. In instances where the Panel chose to identify issues or specific environmental components of concern, some statements were very broad, e.g., predict "impacts of radionuclides on the environment"; predict "effects on fish, birds, and macroinvertebrates"; describe "...the overall impact of increased levels of personal income associated with the various phases of Lepreau II on business activity...".

In other cases, the Guideline statements were qualified by specification of a methodological approach, e.g., describe "sources, types and levels of radioactive releases into the marine and terrestrial (via atmospheric pathways) environments"; predict "the effects of entrainment on various biological parameters (density, diversity, etc.) and population parameters (recruitment) for species of economic significance (fish, shellfish) and species entrained in large numbers".

The final Guidelines issued by the Panel produced little enthusiasm from those who had participated in the scoping process. Those who expected the identification of broad issues, and flexibility to design studies to address them, were dismayed at the document's similarity to "cookbook" style guidelines. This group included the proponent and some members of the Study Advisory Group. Frustration was also expressed by several public participants in the scoping exercise, since many of the issues they had identified were deemed to be outside the Panel's mandate, and therefore did not form part of the Guidelines.

Reviewing the Environmental Impact Statement

The proponent produced an EIS for submission to the Panel 4 1/2 months after the Guidelines were issued. The subsequent review of the EIS by the Panel revealed numerous deficiencies, some identified by the Panel, and others contained in the comments from reviewers, most of whom represented government agencies.

The proponent addressed the deficiencies in a supplementary report, which the Panel subsequently accepted, without the further benefit of government reviewers' comments. The Panel decided to proceed with public meetings at this point. Although several issues remained unresolved, the decision was made on the assumption that these could be dealt with in the public meeting forum.

The decision to proceed to public meetings was a key one for the Panel, as it is in all EARP reviews. This is the point at which there is deemed to be enough information upon which to base a public discussion of environmental impacts. In this case, it is arguable whether the review process was at that stage. On the other hand, given the time constraints and the nature of the Guidelines, it could also be said that the Panel had little choice at this point but to proceed.

To better understand the dilemma which faced the Panel at this stage in the review, some discussion of the way in which the technical merits of an EIS are currently evaluated is required.

Resolving Technical Issues

Commonly in EIA, the technical analyses undertaken by proponents produce scientifically untestable conclusions. The absence of an accepted, objective basis for impact studies has often led to difficulties in obtaining consensus on their contents and significance. This creates a dilemma for the decision-maker. Who should he believe? In the Lepreau II Panel's own words, "the lack of objective analysis" meant that it had to rely on opinion.

The Lepreau II Panel, moreover had to consider many divergent opinions in its review of the EIS. The intention here is not to underrate the value of expert opinions, but to draw attention to the difficulty in reporting to decision-makers on the environmental impacts of a project, where the issues remain clouded. This was certainly the case in this instance.

One mechanism for resolving concerns without objective evidence is for all parties to discuss the issues and work toward a consensus in the areas of divergence. As noted earlier, however, this was virtually impossible in the Lepreau II Review. Under the procedures being used, there could be no discussion of substantive issues between the proponent and the Panel unless it was either: (1) carried out in a public forum with all its attendant microphones, court reporters, and television cameras; or, (2) detailed in the form of written documentation which could be placed in a public file.

The distance set up between the Panel and reviewers, the proponent, and the public by a set of procedures designed to structure "public" input can, and in this case did, work against the resolution of highly technical issues. The operating steps required to ensure the "independance" of the Panel proved to be counterproductive to the free exchange of ideas.

The Panel itself was not unaware of the difficulties it faced in this regard. Concurrent with its decision to move to public meetings on the EIS documentation, it also announced the direct hiring of six independant experts who would review specific issue areas on its behalf. These specialists prepared a so-called "third opinion" for the Panel to consider on subjects expected to be controversial during the public discussion of the EIS material.

In the final analysis, there is little doubt that the technical and scientific aspects of the Lepreau II Review were not resolved to the satisfaction of many participants including the Panel itself. In its final report, the Panel concluded that "the Environmental Impact Statement is not of good scientific quality" and "the review process would have been improved by the provision of greater interchanges among technical experts, ... the Panel and the proponent in a more informal setting to allow discussion of complex technical issues".

There were clearly many other factors involved in the reduced quality of technical examination in this review. Nevertheless, we fully agree that the "public" structure of the process was, itself, partially responsible.

Lepreau II - An Analysis of the Public's Involvement

From the outset of initial planning for the Lepreau II Review, both agencies involved in administering the project placed major emphasis on public involvement. FEARO and Environment New Brunswick each stress the public aspect in their respective approaches to such reviews, despite differences in level of formality and procedure.

The Communities Concerned

The focus of public involvement efforts in this case was the communities surrounding the existing nuclear power station at Point Lepreau, the City of Saint John, N.B., and Fredericton, the provincial capital.

Lepreau I is situated on a rocky point which juts out into the Bay of Fundy approximately 50 kilometres west of Saint John. The surrounding area is characterized by several small, and rather remote, fishing villages, such as Dipper Harbour, Maces Bay, and Chance Harbour. The so-called "inshore fishery" remains the dominant economic force in these local communities. The majority of staff at the nuclear station commute to the plant daily from Saint John, a city of more than 100 000 people. The Lepreau area is well-known for its rugged coastal beauty and is home to a significant number of retirees.

Saint John is a major marine port, the center of heavy industry in New Brunswick, and the province's largest city. It was the focus of major activity during construction of Lepreau I. Fredericton, roughly 100 kilometres north of Saint John, contains the headquarters of N.B. Power, as well as Maritime Nuclear. It is also home to the province's largest university and a significant scientific and technical community. All planning and executive functions concerning Lepreau I, as well as the Lepreau II proposal, are centered in Fredericton.

A final point to be made in this brief description of the communities concerned relates to the economic context in which the Lepreau II Review was carried out. Unemployment in New Brunswick is chronically high in relation to the rest of Canada. During the review period, this situation was even more pronounced, given the state of the national economy. In Saint John, N.B., unemployment in the construction industry has been described as being at "crisis levels" for several years.

Efforts to Promote Public Involvement

A vigorous attempt was made by the Lepreau II Panel and its Secretariat to promote public participation throughout the process. A total of 11 press statements were issued during the 18 month period, including the Ministerial press conference announcing the Review; 13 separate documents were distributed publicly and 16 public meetings were held in six different locations.

A bulk mailing list exceeding 200 names received information on a regular basis; a toll-free telephone enquiry service was established within New Brunswick to assist citizens in obtaining information on how to take part in the process; a series of advertisements was placed in provincial newspapers; posters were used to promote public meetings; staff and Panel members gave dozens of broadcast and print interviews to the news media; and, during the final public meeting series, a free bus service was provided to assist local residents in attending the events.

The Public's Response

Despite the priority placed on stimulating public input, the number of people from outside government and industry who took part in the process was quite low from beginning to end. In fact, the level of public involvement waned as the Lepreau II Review continued.

The initial open house sessions prompted some interest from individual citizens, most often from people who were interested in socio-economic issues such as the employment opportunities that the project might offer, or criticisms of the existing plant's emergency warning system. During the Panel's scoping workshops, the focus moved to government agencies, industry and labour groups, as well as a small but vocal coalition of environmental, conservation and peace organizations.

Following issuance of the Panel's Guidelines, interest in the process by this latter group receded dramatically. The Review terms of reference had specifically excluded many of the issues they had raised during workshops. Not surprisingly, these issues were not included in the Panel's Guidelines. In addition, the coalition's request to Ministers for intervenor funding had been denied, with the resultant claim that effective participation in the Review could not be mounted. The organizations in question subsequently boycotted the final public involvement meetings held by the Panel.

Of the 20 written submissions the Panel received in response to the EIS, 17 were from government agencies or industry and trade groups. The final public meeting series was held over a two week period in late November, 1984, in three separate locations. It attracted active participation by less than 10 local residents, the majority of whom were interested in socio-economic concerns.

This is not to say that the meetings themselves were completely unattended. During the two week period, the Panel heard from more than 20 different spokesmen representing the proponent. A large number of government agency staff took part as well, and the meetings attracted a significant turnout of news media and other observers.

Examining the Level of Public Response

By any measure, the Lepreau II Environmental Assessment Review was unsuccessful in involving the public in its examination of the environmental impacts associated with the proposal. In its final report, the Panel suggested several possible reasons for this. We will expand on these and offer a few more for consideration.

First, there is the very real possibility that the Lepreau II proposal was something of a bore to many New Brunswickers, at least as far as its environmental impacts were concerned. The fact is that the proposal was to build a virtual carbon copy of an existing plant which had been functioning without incident for two years. As noted earlier, some had expected the Lepreau II Review to become a "national battleground" on nuclear power. It's clear the wording of the Panel's terms of reference would have prevented this from happening, even if the national anti-nuclear movement had decided to venture east to New Brunswick.

Secondly, it is important to understand that in provinces like New Brunswick, with a long history of development proposals which did not get off the drawing board, the average person often exhibits a healthy degree of scepticism about the economic viability of virtually anything proposed, particularly if the source of the proposal is central Canada. This type of response is unlikely to prompt active participation in an environmental review, and even less likely when the review's terms of reference exclude consideration of the stated rationale for the project (in this case, the power export scenario).

Another form of scepticism stems from the view that EIA's in general are window-dressing exercises which purport to involve the public in decision-making, but, in fact, do not. One has to accept that this opinion is shared by numerous members of the public, although we obviously do not agree.

Several other suggestions are made in the Panel's final report which could account for the lack of an active public response. These include a statement from one of the few local people who did participate that residents of the Lepreau area were tired of living "in a fishbowl" and being subjected to a magnifying glass by "government" people from outside their tightly knit community.

In the final analysis, the low level of public response was probably related to some degree to all of the above. In our view, however, an equally important factor was the overly formal structure of the public participation procedures, and the highly technical nature of the subject matter, when the meeting sessions did take place.

As stated earlier, we believe the resolution of technical issues during the review was hampered by the fact that the Panel had no opportunity to discuss such issues with interested parties, except in the full-fledged public meeting forum, or the dry medium of written submissions. Success in prompting meaningful public involvement was hampered by the same problem. Since the Panel and others with a technical interest had no other option, the final public meetings became an exhaustive attempt to resolve technical issues, in which the public had little or no interest, and almost no understanding. The only summary material which had been publicly distributed during the Lepreau II Review was the proponent's summary of the original EIS.

In scheduling the final meetings, an attempt was made to restrict highly technical discussions to day sessions and open up evenings and weekends for broader issues. This effort, however, produced little change in the "ambience" of the meeting series, which attracted fewer and fewer participants over a ten day period. With a few notable exceptions, presentations heard at the "general sessions" were either technical additions from government reviewers, or short statements from trade and industry groups who wanted an immediate start on construction.

One brief example may illustrate the problem which the Panel, and the review as a whole, faced in this regard. During one of the meeting sessions in Saint John, a technical consultant representing the proponent, and an independant reviewer hired by the Panel, spent most of an afternoon arguing politely about methodology for analysing thermal plume behaviour, although they were both in agreement that the environmental impacts involved were of no significance in regard to Lepreau II. Near the end of this debate, a local television reporter began interviewing members of the audience, asking them individually whether they understood anything that was being said. The response was one shaking head after another.

Conclusion

In our view, the Lepreau II experience demonstrates that neither the technical examination nor public involvement aspects of the process were a major success, from the perspective of EIA administration. The Environmental Assessment Panel worked extremely hard to overcome these shortcomings and, in the final analysis, produced a report of significant quality and value. It makes a number of purposeful recommendations to the Ministers of the Environment. Some of these deal with process issues as well, reflecting the Panel's recognition of shortcomings in that area.

In its final report, the Panel goes beyond the question of Lepreau II to recommend a broader review of the nuclear power option within Canada's national energy policy. It also recommends development of intervenor funding mechanisms to aid involvement by public groups in future reviews, and increased emphasis on environmental monitoring to ease the process of baseline data collecting during EIA studies.

As noted earlier, the Panel recommended that there be greater informal interchange among technical experts, the Panel and the proponent in future reviews. To this, we would add several recommendations of our own. To effectively balance requirements for public participation and technical examination in environmental impact assessment, major emphasis should be placed on the following administrative elements:

1. Provide opportunities for those review participants with a technical perspective to discuss issues of concern through an in-depth multi-

disciplinary approach. There is no need for such discussions to be held "behind closed doors". At the same time, there is no need for them to be planned and promoted as major events for individual citizens.

2. Emphasize an informal atmosphere to elicit response and comments from the public, particularly in non-urban communities, and ensure that citizens have access to summary material which objectively portrays the essence of predicted impacts.
3. Avoid, wherever possible, situations in which exclusionary terms of reference are established, and the public is then asked to help in the process of identifying issues of concern about the proposal.
4. When a Panel is establishing EIS Guidelines, ensure they are internally consistent in approach, and concentrate on identifying key issues, rather than study methodologies. In this regard, consideration should be given to forming Panels with expertise in a broader decision-making context, as opposed to technically-oriented disciplines.
5. Where a Study Advisory Group, or similar body, is established, ensure that procedural requirements do not prevent close collaboration between its members and members of the Panel.
6. In planning a review, establish goals and objectives regarding technical examination and public involvement which are realistic in light of the following considerations:
   - the time and resources available;
   - past EIA experience in the jurisdiction concerned;
   - the ecological, demographic and economic character of the region in which the project is proposed; and
   - the social, cultural and political traditions which prevail within the communities of greatest potential impact.

SUIVIS ET CONTROLES ENVIRONNEMENTAUX REQUIS PAR LE PUBLIC

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Dans une recherche entreprise en 1983, nous avons tenté d'analyser systématiquement les procédures d'audiences publiques sur l'environnement (au Canada, en Ontario et au Québec), tenues dans le cadre des processus d'évaluation d'impact environnemental. Notre analyse s'intéressait essentiellement aux intervenants publics participant à ces audiences. Nous étions intéressés d'abord à identifier les caractéristiques de ces intervenants, ensuite à évaluer le contenu de leurs interventions. A cette dernière fin, nous avons analysé tous les mémoires écrits déposés par des intervenants publics. Compte tenu de l'état d'avancement de nos travaux, le contenu de cette communication n'est basé que sur l'analyse du discours des intervenants de la procédure québécoise. Tous les mémoires (244) déposés au cours des treize premières audiences publiques ont été analysés. Cela représente 244 intervenants et 57.8% de tous les intervenants ... les autres ne s'étant exprimés que verbalement.

L'analyse des mémoires écrits déposés par les intervenants a été faite à l'aide d'une grille d'analyse thématique qui comptait huit thèmes:

1. Le promoteur et ses responsabilités propres
2. L'étude d'impact déposée par le promoteur
3. Le projet, sa nature, ses composantes, sa localisation
4. L'environnement, son état, ses composantes, son altération
5. Les impacts eux-mêmes, de toutes natures
6. Les options ou alternatives au projet, leurs variantes
7. <u>Les mesures de suivi, de contrôle, de mitigation</u>
8. La procédure d'évaluation d'impact, le rôle particulier du Bureau d'audiences publiques et des commissaires.

(*) Les données traitées dans cette communication sont tirées d'une recherche subventionnée par le Conseil de Recherches en Sciences Humaines du Canada.

Je vous propose de considérer particulièrement et uniquement, dans le cadre de cette conférence, les positions exprimées par les intervenants en ce qui concerne les mesures de suivi, de contrôle et de mitigation (thème 7).

Nous questionnerons ainsi l'objectif même des processus d'évaluation d'impact environnemental et des procédures de consultation du public dans le cadre de ces processus: assurer le caractère démocratique du processus de décision et améliorer la nature même de la décision. Si les consultations publiques sur l'environnement dépassent le seul exercice de démocratie directe, il faut supposer qu'elles permettent de relever des informations nouvelles mais aussi de dégager les conditions d'acceptabilité des projets, d'élaborer les conditions assorties à leurs autorisations, d'identifier les responsabilités des suivis et contrôles.

Pour évaluer ce dernier objectif, tel que nous venons de l'identifier, il faudra un jour vérifier si les décideurs ont tenu expressément compte des avis exprimés par les intervenants au cours des consultations publiques. Pour réaliser une telle vérification, il faudra avoir d'abord enregistré et évalué les avis exprimés par les intervenants. C'est à ce dernier niveau que nous nous arrêtons pour le moment.

Le discours des intervenants publics

Curieusement, dans la procédure québécoise, sur les treize (13) premières audiences publiques tenues par le BAPE (Bureau d'audience publique sur l'environnement), les intervenants publics ont parlé relativement peu des mesures de contrôle, de suivi et de mitigation. En fait, des huit thèmes retenus pour l'analyse des mémoires déposés, le thème (numéro 7) des mesures de contrôle, suivi et mitigation est le thème le moins exploité par les intervenants. Dans l'ordre, les intervenants parlent du promoteur, de son projet, des impacts, de l'environnement, de l'étude d'impact, des alternatives et options, de la procédure d'évaluation d'impact et enfin seulement des suivis, contrôles et mesures de mitigation. Seulement 45% des intervenants utilisent ce thème. Force nous a été de constater que l'audience publique est plutôt un exercice politique de participation à la décision. Les intervenants publics, sous un modèle plutôt de confrontation, interviennent essentiellement sur le projet et le promoteur. Ils considèrent en fait, mais à tort, l'audience publique comme un exercice de décision, en négligeant de l'exploiter comme mécanisme de médiation, de conciliation ou même de négociation sous la présidence neutre des commissaires.

Dans notre analyse thématique des mémoires des intervenants, chaque thème était évalué sur une échelle (de 1 à 4) exprimant la distance que l'intervenant prend sur chaque thème par rapport au contenu de l'étude d'impact. Ainsi, en ce qui concerne le thème (7) sur les mesures de suivi, de contrôle et de mitigation, nous avons évalué le discours de l'intervenant sur l'échelle suivante:

1. les mesures proposées par le promoteur sont questionnées de façon ponctuelle
2. la fiabilité de ces mesures avancées par le promoteur est mise en cause
3. les intervenants proposent une gestion et une évaluation intégrée et systémique de l'ensemble des mesures
4. les intervenants proposent de revoir le projet selon un modèle de planification intégrée impliquant toutes les responsabilités associées directement ou indirectement.

Le degré de discours de l'ensemble des intervenants sur les normes de contrôle, de suivi et de mitigation ne dépasse pas le niveau 2 (il est en fait de 1.97). C'est dire qu'ils ne sont pas allés plus loin que de seulement questionner la fiabilité des propositions des promoteurs. Les intervenants ne proposent pas des mesures nouvelles, ne les formulent pas comme des conditions d'acceptabilité des projets, n'exigent pas une planification et une gestion intégrée de l'ensemble des conditions d'autorisation des projets.

Nous avons observé, en considérant l'ensemble des thèmes, que l'intervenant moyen ne fait que prendre acte de la responsabilité du promoteur et des mesures de contrôle, de suivi et de mitigation, en minimisant le questionnement de l'étude d'impact. Par contre, il tend à remettre fondamentalement en cause le projet lui-même, en utilisant une représentation de l'environnement comme patrimoine social collectif et en faisant valoir toutes les alternatives possibles et imaginables. En s'opposant fondamentalement au projet, selon le principe de "any where but not in my backyard", l'intervenant moyen ne se rend donc pas jusqu'à la négociation des conditions d'insertion et d'autorisation des projets. L'ensemble de la procédure d'évaluation publique des impacts est donc interprétée par l'intervenant public plus comme une occasion de faire pression sur le décideur que comme une occasion de négocier publiquement les conditions d'acceptabilité d'un projet.

Les types d'intervenants et leur discours

Nous avions les moyens de distinguer, de la position de l'intervenant moyen, celle de certains types d'intervenants. Nous avons constaté que les intervenants individuels, plus que les groupes et les représentants des collectivités locales, étaient prêts à entreprendre un début de négociation publique des conditions d'insertion et d'autorisation des projets. Les individus, plus que les autres types d'intervenants, proposent des mesures nouvelles, exigent une sorte de protection. Les intervenants locaux, plus que les représentants des groupes d'intérêts nationaux et régionaux, semblent aussi plus disposés à entreprendre la négociation publique. Les intervenants individuels et locaux sont en fait des résidents locaux éclairés qui représentent les enjeux et intérêts collectifs soulevés par les problèmes d'insertion des projets. Ils sont donc plus conscients des impacts immédiats des projets et semblent plus disposés à en discuter les suivis et contrôles, les mesures d'accompagnement et de compensation.

Nous avons généralement constaté que les audiences publiques sur l'environnement au Québec mettaient en présence des intervenants publics foncièrement différents. Les premiers, représentant des groupes et associations reconnus, défendent d'abord des enjeux environnementaux généraux et ils utilisent les audiences publiques comme moyen de pression politique sur le décideur. Les seconds, agissant le plus souvent à titre individuel, soulèvent des enjeux et des intérêts locaux qui les amènent à adopter une attitude plus conciliatrice pour débattre et négocier les conditions d'insertion et d'acceptabilité des projets. Cependant, curieusement, ce deuxième type d'intervenants est celui qui le plus généralement adopte une position globale négative vis-à-vis le projet.

Nous avons interprété que les intervenants les plus prêts à négocier des mesures de contrôle, de suivi et de compensation étaient aussi les intervenants les plus incertains quant à l'actualisation de ces mesures et qu'ils préféraient finalement prendre position nettement contre l'autorisation des projets pour éviter les risques.

Les requêtes des intervenants publics

Considérons maintenant dans le détail la nature des avis exprimés par les intervenants, quand ils formulent des demandes de contrôles, de suivis et de mesures mitigatrices. Pour les fins de cette observation, nous avons utilisé une grille à deux dimensions. Cette grille comporte deux axes: sur le premier nous trouvons le niveau où s'exprime la demande, sur le second nous inscrivons la modalité accompagnant la demande (voir Grille d'analyse).

Grille d'analyse

REQUÊTES DES INTERVENANTS PUBLICS

Modalité / Nature	Initiative Décision	Participation du Public	Mécanismes nouveaux	VIDE
Projet conception				
Projet construction				
Projet opération				
Conditions particulières				
Suivis et études				
VIDE				

Le niveau où s'exprime la demande concerne soit le projet, la réalisation du projet ou sa mise en opération, soit des conditions générales entourant la décision d'approbation et ne relevant pas du projet lui-même, soit des exigences de suivi environnemental relatives à l'état de l'environnement indépendamment du projet lui-même.

Exemples:

Mesures relatives au concept du projet:

"élargissement d'une zone tampon prévue".

Mesures relatives à la construction:

"élaboration d'un plan précis de dynamitage".

Mesures relatives à des conditions particulières:

"construction d'une base de loisirs sur des terres soustraites aux risques d'inondation".

Mesures relatives à des suivis environnementaux:

"évaluation permanente du repeuplement des eaux fluviales par l'alose savoureuse".

Les modalités qu'accompagnent une demande réfèrent soit au pouvoir d'initiatives et de décisions relatif à la prise en compte des demandes et avis exprimés, soit aux mécanismes particuliers par le biais desquels seront réalisées les demandes, soit à la prise en compte de la participation publique dans l'opérationnalisation et la mise en oeuvre des réponses aux demandes et avis exprimés.

Exemples:

Mesures adressées à un pouvoir d'initiative et de décision:

"une plus large marge d'initiative concédée aux bureaux régionaux des services de protection de l'environnement".

Mesures proposant un mécanisme particulier:

"un protocole d'entente globale entre le promoteur, les services ministériels et la municipalité".

Mesures associant la participation continue du public:

"une autre audience publique à l'étape de mise en opération".

La grille constituée de ces deux axes permet de croiser niveaux de discours et modalités accompagnant une demande ou un avis. Nous tentons ainsi de construire des énoncés types qui associent à la nature de la demande, le destinataire final à qui est adressé cette demande, le mécanisme suggéré pour son opérationnalisation et l'exigence de la poursuite de la participation du public.

Exemples:

Projet - Décision:

"nous demandons au Ministre de l'Environnement de rejeter le tracé Est".

Projet - Mécanisme:

"qu'une tierce personne évalue de façon comparative les tracés proposés".

Projet - Participation:

"qu'une autre audience publique soit tenue sur les modifications apportées au projet par le promoteur".

Construction - Décision:

"que les services de protection de l'environnement approuve le plan de dynamitage".

Construction - Participation:

"que le public soit informé et consulté sur les routes d'accès au chantier".

Construction - Mécanisme:

"qu'un protocole intervienne entre la municipalité et le promoteur pour le maintien en état des routes d'accès au chantier".

Mise en opération - Participation:

"qu'un comité de riverains soit informé et consulté régulièrement sur les modes de déversement des eaux usées".

Mise en opération - Mécanisme:

"qu'un groupe indépendant soit responsable de vérifier l'utilisation maximum de réservoir pour éviter les risques d'inondation".

Conditions - Décision:

"que les services de protection de l'environnement réalisent une étude d'impact sur les ressources archéologiques".

Conditions - Participation:

"que le public soit associé à la réalisation du schéma d'aménagement d'un espace de loisir sur les nouvelles berges".

Conditions - Mécanisme:

"qu'un centre de formation en navigation maritime soit installé dans la municipalité pour former entre autres des spécialistes en circulation des méthaniers".

Suivi - Décision:

"que le ministère fédéral des transports voit à l'installation d'un centre d'études sur la navigation maritime et le déplacement des glaces".

Suivi - Participation:

"qu'une association locale de conservation de l'environnement soit subventionnée pour des études de suivi sur la qualité de vie".

Suivi - Mécanisme:

"création d'un conseil de surveillance du capital forêt".

Nature des requêtes

Nous avons appliqué cet instrument d'analyse sur les 13 premières audiences publiques sur l'environnement tenues par le BAPE, de 1979 à 1983. L'analyse n'a porté que sur le contenu des mémoires écrits déposés par les intervenants.

491 interventions publiques ont été enregistrées sur ces treize audiences;
244 interventions publiques ont été accompagnées du dépôt d'un mémoire.

Les mémoires sont de natures inégales. Ils expriment des avis, des opinions, des requêtes; mais ils sont aussi des pétitions, des rapports d'assemblées délibérantes. L'analyse, que nous avons faite pour relever les demandes de suivi, de contrôle et de mesures de mitigation, a été réalisée de façon très serrée. Nous n'avons retenu que des demandes explicites et formelles; nous n'avons pas retenu l'opinion, le jugement, la remarque. Compte tenu de cette règle d'analyse, nous avons relevé 180 requêtes expresses et explicites exprimées par 110 intervenants. Constatons que moins de la moitié des intervenants ayant déposé un mémoire arrivent à exprimer au moins une requête expresse relative à un suivi, à un contrôle ou à une mesure de mitigation.

67.2% des requêtes portent sur le projet lui-même, sur sa conception, sa réalisation ou son opération.

6.7% des requêtes portent sur des mesures de suivi ou des conditions indépendantes du projet lui-même.

26.1% des requêtes n'expriment aucune requête formelle relative au projet, aux suivis et conditions, mais suggèrent des interventions en identifiant l'acteur responsable, la place du public ou des mécanismes particuliers.

Nous constatons ainsi que les intervenants publics expriment dans leurs requêtes principalement des demandes relatives à la diminution des risques, inconvénients et impacts. Ils expriment très secondairement des requêtes relatives à l'amélioration des conditions de vie locales.

75.2% des requêtes relatives au projet lui-même concernent sa conception.

5.8% sont relatives à l'opération du projet quand il aura été construit.

19.0% sont relatives à la construction du projet - travaux de mise en oeuvre et de réalisation.

Les intervenants publics sont donc généralement beaucoup plus intéressés à influencer la conception du projet, à y voir apporter des modifications ou à voir adoptées des variantes qu'à introduire des mesures de modération des risques et inconvénients pendant la période de construction et au cours de la durée d'opération du projet. Ils cherchent donc beaucoup plus à influencer la décision finale sur le projet qu'à négocier des conditions relatives à sa mise en oeuvre et à son opération. Ils questionnent donc d'abord l'acceptabilité du projet.

66.7% des requêtes explicites non relatives au projet lui-même demandent des suivis environnementaux généraux.

33.3% de ce type de requête (non relatives au projet lui-même) demandent des conditions formelles de contrôle ou de mitigation.

en fait, 2.2% seulement de l'ensemble <u>de toutes les requêtes</u> portent formellement sur des conditions pour l'amélioration des conditions de vie (par rapport à celles relatives à la dimimution des risques).

Force est de constater que les intervenants publics ne se servent pas des audiences publiques pour négocier les conditions du développement de leur communauté locale mais pour forcer l'évaluation de l'acceptabilité du projet et pour obliger la protection de leur environnement.

Modalités associées à l'expression de requêtes

Les requêtes formelles qu'avancent les intervenants publics dans leurs mémoires déposés aux audiences publiques sur l'environnement sont parfois adressées de façon précise, accompagnées de mécanisme de mise en oeuvre et accompagnées d'une exigence de prise en compte du public dans la suite à donner à ces requêtes:

45.6% de l'ensemble des requêtes formulent ainsi une adresse de responsabilité d'initiative ou de décision, une proposition de mécanisme, de mise en oeuvre ou de poursuite de la participation du public.

Ce type de requêtes se répartit de la façon suivante:

50.0% désignent une responsabilité d'initiative ou de décision.
3.7% exigent une poursuite de la participation du public.
46.3% proposent un mécanisme de mise en oeuvre de l'objet de leur requête.

Les intervenants publics adressent donc leur requête sous forme de revendication sans exiger une prise en charge ou une participation aux suites à donner à leurs requêtes. La forme revendicative l'emporte sur la volonté de négocier le partage des responsabilités. Par contre, il faut relever qu'un bon nombre de requêtes sont adressées non pas à un décideur mais impliquent dans l'esprit des requérants un mécanisme nouveau, le plus souvent de concertation, en marge des hiérarchies et réseaux traditionnels de décision.

Les requêtes complètes: objet et modalité

Un des objectifs de l'analyse des requêtes avancées par les intervenants, par le moyen de la grille croisée, était d'enregistrer le maximum de requêtes complètes exprimant à la fois un objet et un moyen de mettre en oeuvre l'objet de cette requête. Nous espérions ainsi pouvoir enregistrer des énoncés complets:

objet de la requête	-	à qui est adressé cette requête
objet de la requête	-	moyen de réaliser l'objet de cette requête
objet de la requête	-	participation du public au contrôle de la réalisation de l'objet de cette requête.

En fait, 71% de l'ensemble des requêtes sont exprimées de façon non croisée; de celles-ci 63.0% énoncent un objet mais n'associent aucun moyen, aucun mécanisme, aucun décideur; 23% identifient une responsabilité de décision, ou un mécanisme de prise en charge sans associer cette responsabilité ou ce mécanisme à la prise en charge de l'objet d'une requête; enfin, 14% des requêtes avancent une proposition générale, le plus souvent de nature politique, qui n'a ni rapport explicite avec le sujet en cause à l'audience, ni ne désigne une modalité particulière de prise en charge.

29% de l'ensemble des requêtes sont cependant exprimées de façon croisée, associant un objet à une responsabilité, une modalité ou un mécanisme de mise en oeuvre. De ces requêtes croisées,

86.8% concernent le projet lui-même,
13.2% concernent des suivis et conditions non expressément liés au projet.

Des requêtes croisées qui concernent le projet,

54.3% concernent la conception du projet,
28.3% l'opération du projet achevé,
17.4% la construction du projet.

Les intervenants adressent de façon plus précise des revendications explicites quand elles concernent le projet lui-même et principalement sa conception. Cela confirme ce que nous avions déjà constaté, à savoir que les intervenants s'intéressent d'abord à la décision d'acceptabilité du projet et tentent essentiellement d'influencer cette décision. Ils le font cependant non pas tant en s'assurant une participation suivie, ni en désignant une responsabilité de décision ou d'initiative, mais plutôt en proposant des mécanismes nouveaux de concertation ou de conciliation (négociation, arbitrage).

Ainsi, de toutes les requêtes croisées,

41.5% désignent une responsabilité de décision ou d'initiative.
5.7% impliquent une poursuite de la participation du public.
52.8% proposent un mécanisme nouveau de mise en oeuvre.

En somme, et compte tenu des résultats déjà présentés, les requêtes les plus précises et les plus détaillées, impliquent un objet et une modalité, concernent principalement la mise en place de mécanisme de révision et de contrôle du concept, de la construction et de l'opération du projet. Ce constat général entraîne au moins deux observations: premièrement, les intervenants publics revendiquent surtout un contrôle sur le sujet lui-même, et un contrôle duquel ils s'excluent; deuxièmement, ils n'attendent pas que ces contrôles soient exercés par les responsabilités instituées et reconnues, mais qu'ils soient exercés par des mécanismes nouveaux de concertation où l'Etat n'est qu'un des partenaires.

Constats généraux

Nous retenons de cette brève analyse les observations suivantes:

1) Moins de la moitié des intervenants aux audiences publiques sur l'environnement expriment des requêtes précises et explicites et débordent le simple énoncé de questions, d'avis et d'opinions.
2) Les requêtes exprimées concernent principalement le projet, mais le projet dans sa conception originale. Les requêtes expriment donc d'abord une volonté de participer à la décision essentielle sur l'acceptabilité du projet.
3) Les intervenants publics ne tentent pas de négocier, à l'occasion de l'insertion d'un projet dans leur collectivité, des conditions générales d'amélioration de leurs conditions de vie. Ils tentent essentiellement d'engager une réduction des risques, inconvénients et impacts.
4) Très peu de requêtes sont exprimées comme des revendications complètes impliquant un objet, un destinataire ou une modalité. Les requêtes exprimées de façon complète concernent essentiellement le projet lui-même.
5) Ces requêtes complètes, relatives au projet, proposent principalement la mise en place de mécanismes nouveaux pour policer et contrôler le projet, de sa conception, à sa mise en oeuvre et à son opération.
6) Les intervenants publics ne requièrent donc pas particulièrement une poursuite de la participation publique, ni une responsabilité unique de l'Etat ou du promoteur. Ils attendent des mécanismes souples de contrôle, neutres et relativement rapprochés des collectivités locales.

Conclusion

L'audience publique sur l'environnement est assimilable plus à un mécanisme de démocratie directe, où la décision relative à l'acceptabilité du projet domine le débat. Dans cette direction, le débat devient à la fois plus polémique et plus politique et peut être contrôlé facilement par les grands groupes d'intérêts économiques, sociaux et environnementaux.

Peu d'intervenants publics arrivent à se servir de l'audience publique pour avancer des requêtes précises qui pourraient engager un début de conciliation ou de négociation sur le concept du projet, sur les mesures d'accompagnement pour réduire les risques et sur les mesures de compensation pour faire participer le projet au développement de la collectivité.

Il y a lieu de chercher des moyens précis, distincts de l'audience publique, pour favoriser l'expression de requêtes précises et pour leur fournir le cadre d'un exercice de négociation. Cette recherche doit commencer par l'évaluation précise des champs de retombée des impacts des projets et des types de publics touchés. Elle doit se poursuivre dans la conception de mécanismes qui permettent à des publics différents d'être écoutés à des moments et à des occasions différentes. Enfin, il faut trouver les moyens de rendre crédibles les exercices de négociation en attribuant explicitement des pouvoirs de conciliation aux commissaires présidant les réunions publiques.

Annexe

Projets soumis à audience publique dans le cadre de la procédure québécoise d'évaluation d'impact environnemental, de 1979 à juin 1983.

1. Projet autoroutier Dufferin-Montmorency sur les battures de Beauport.
2. Projet d'augmentation d'emmagasinement des eaux dans l'Outaouais supérieur en particulier au réservoir des Quinze et au grand lac Victoria.
3. Projets de gazoducs Trans-Canada et Quebec and Maritimes Pipelines.
4. Réseau de transport d'électricité La Grande: Tronçon La Vérendrye - Duvernay.
5. Projet Trans-Canada Pipelines: usine de liquéfaction et de regazéifaction du gaz naturel à Lauzon et à Sept-Iles.
6. Projet de construction d'un terminal méthanier à Gros Cacouna.
7. Projet Stablex d'implantation d'une usine de traitement des résidus industriels.
8. Projet de centrale hydro-électrique Delaney.
9. Projet du quai Bellerive pour fins récréatives et de déversement occasionnel de neiges (Montréal).
10. Projet de remplacement d'un évacuateur de crues sur la Rivière-des-Prairies et d'arasement d'un haut fond.

11. Programme de pulvérisations aériennes d'insecticides contre la tordeuse du bourgeon de l'épinette.
12. Projet CIP de dragage à l'embouchure de la rivière Saint-Maurice.

PUBLIC INVOLVEMENT IN TRANSMISSION LINE PLANNING: TWO SIMILAR PROJECTS WITH DIFFERENT PUBLIC PROGRAMS

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Introduction

The expansion of Ontario Hydro's 500 000 volt bulk transmission system is a top priority for the 1980's. Planning for the expansion of the system began in the early 1970's but was delayed by the investigations of the Royal Commission on Electric Power Planning (RCEPP) through the period 1974 to 1980. In 1980, RCEPP's final report endorsed the need for new 500 kV facilities in the Eastern and Southwestern portions of Ontario and detailed planning was initiated (see Figure 1).

Public involvement programs for these regional studies were incorporated in two components: the Bruce to Essa study in Southwestern Ontario, and the Lennox to Ottawa study in Eastern Ontario. The studies took place at approximately the same time; were supported by study teams drawn from the same departments; made use of similar environmental study methodologies; and were subject to the same government approvals process. They differed, however, in their approach to involving the public and had significantly different results. These contrasts and similarities are the subject of this paper.

The Two Projects and Their Common Features

The Bruce to Essa study required a double circuit 500 kV line of approximately 160 km, to connect the Bruce Nuclear Generating Station on Lake Huron with the Essa Transformer Station, near Barrie (see Figure 2).

The Lennox to Ottawa study required two single circuit 500 kV lines on the same right-of-way of approximately 180 km to supply a bulk transmission connection to the Ottawa area from the switchyard at the Lennox Generating Station near Kingston (see Figure 3).

Both these studies shared 1) similar priorities and schedules; 2) similar facilities; 3) a common approvals process; and 4) common study methodology.

1) Both were long delayed projects, which were needed well before the then practical in-service dates of 1988-89.

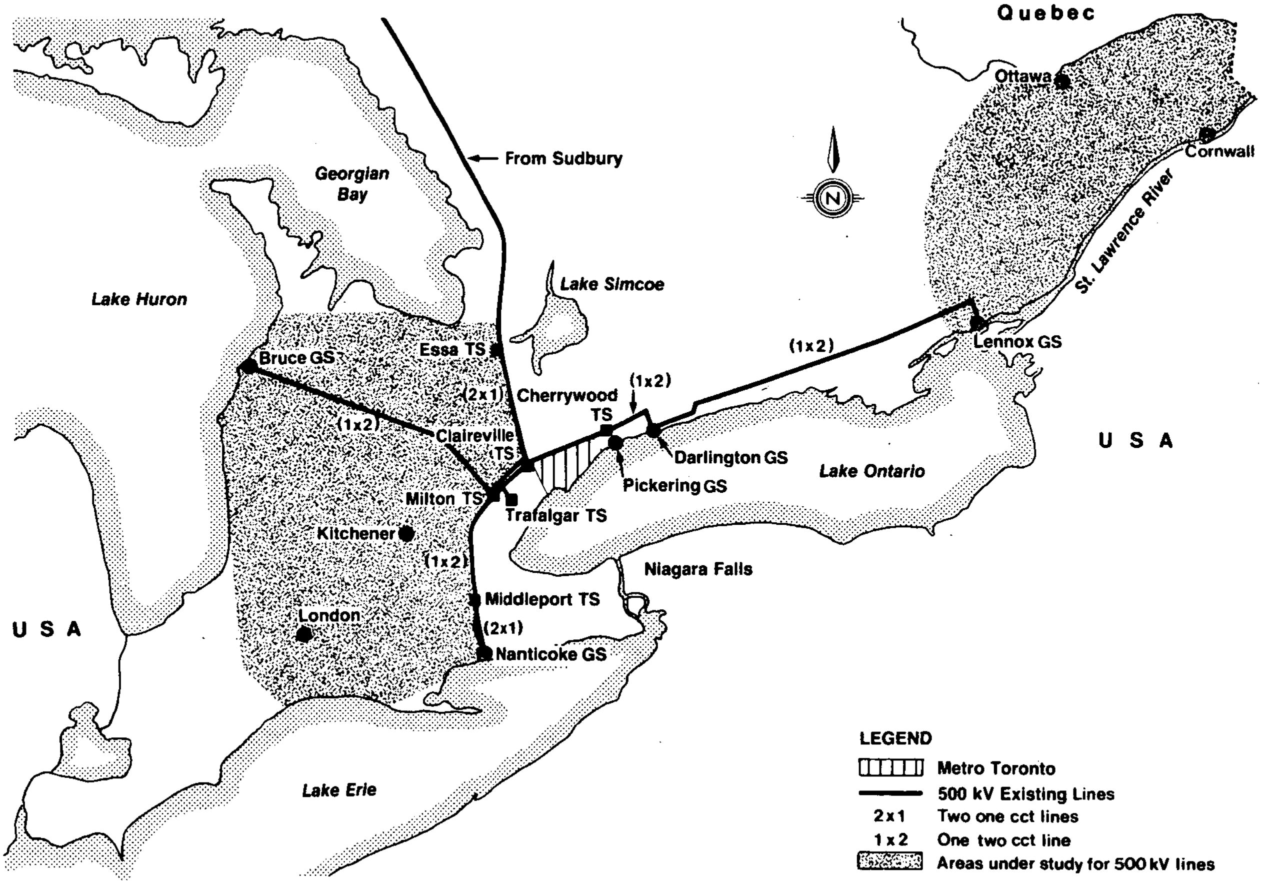

FIGURE 1 500 kV TRANSMISSION SYSTEM, SOUTHERN ONTARIO 1984

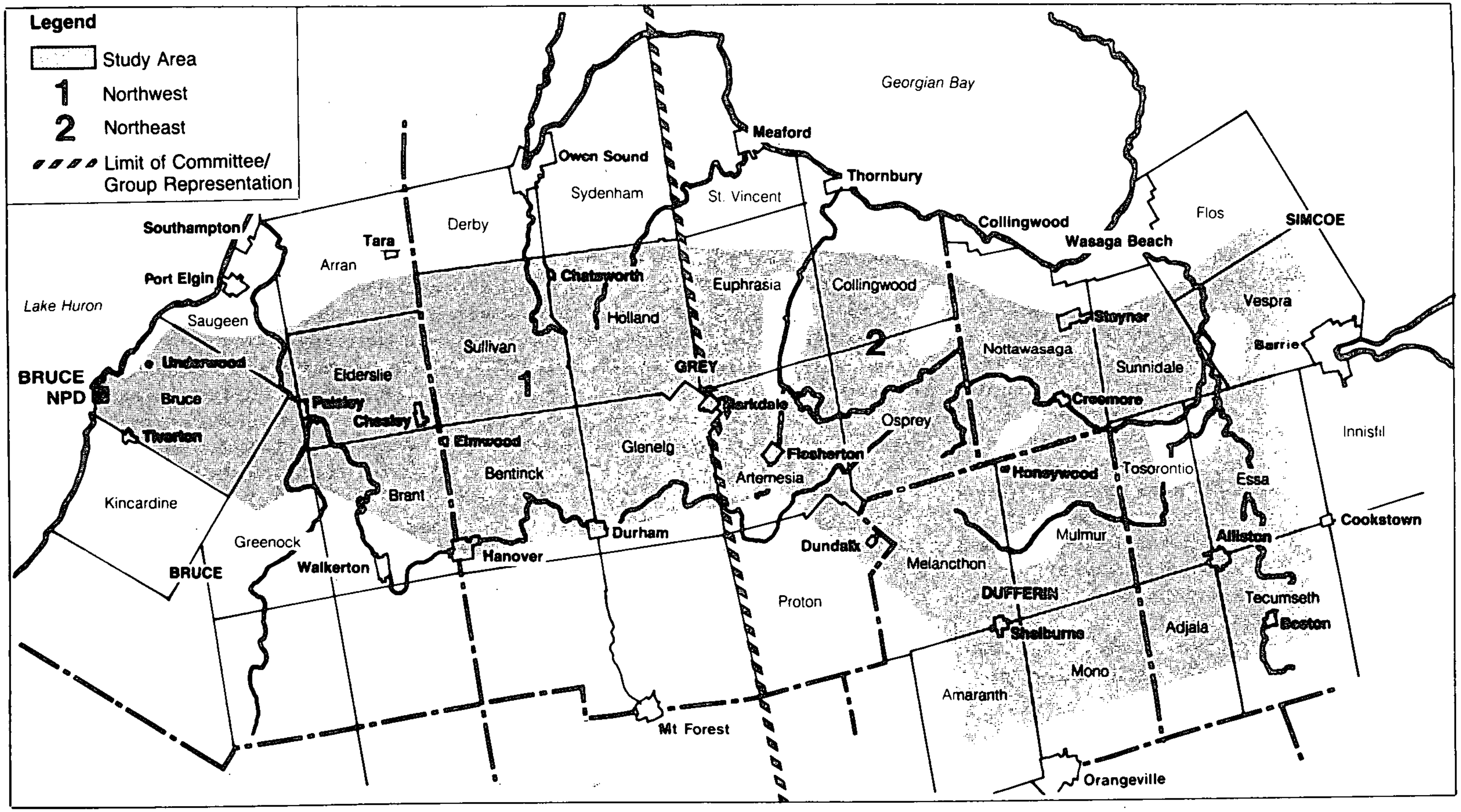

FIGURE 2 - BRUCE TO ESSA STUDY AREA - WORKING GROUPS

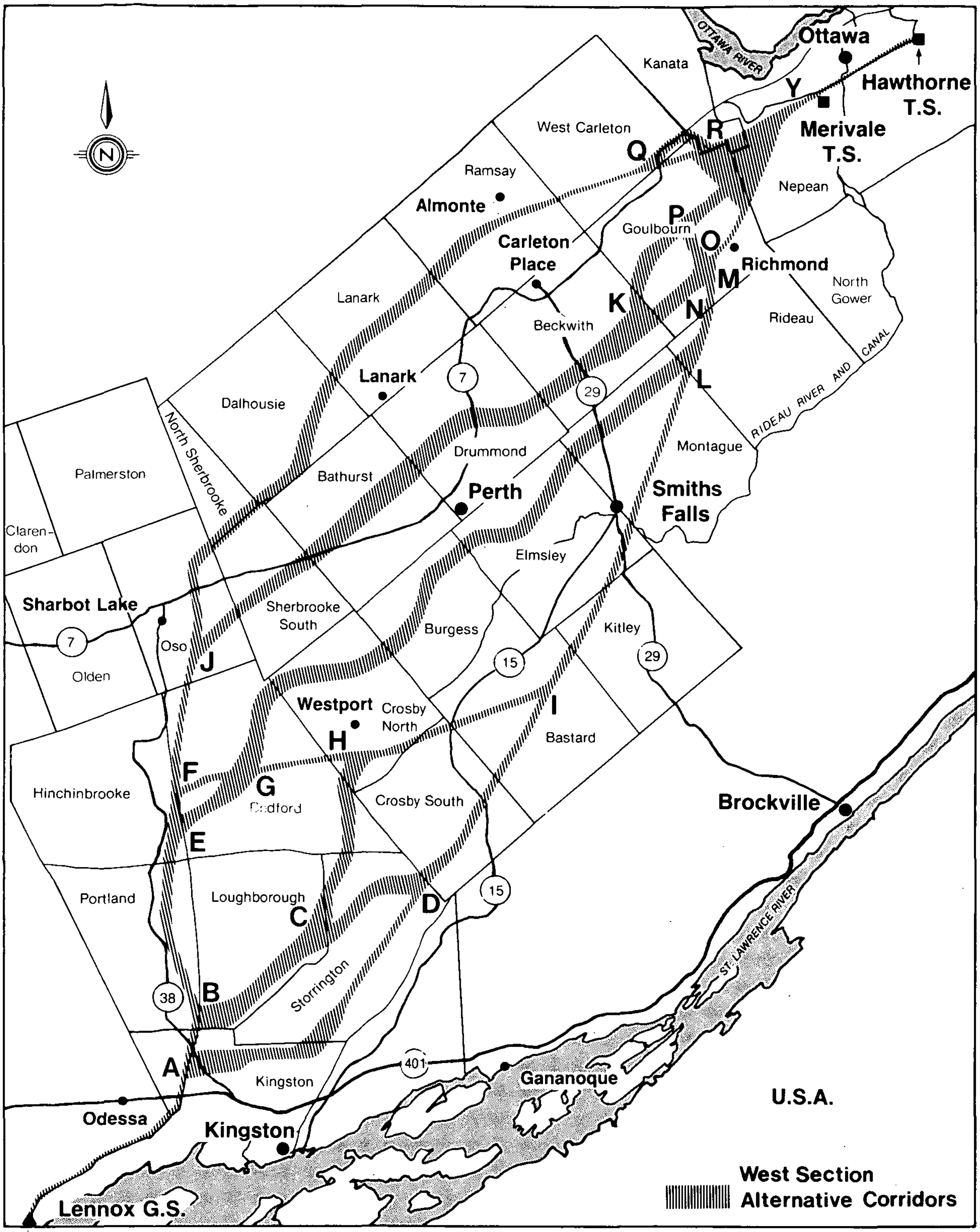

FIGURE 3 ALTERNATIVE CORRIDORS

2) Both studies sought to connect 500 kV lines between the established points of Generating Station switchyards and transformer stations.
3) Both projects proceeded under Ontario's Consolidated Hearings Act and made use of a two stage hearings and approvals process. A plan stage Environmental Assessment (EA) and public hearing by which the need, the type of facilities and the geographic area for the route level studies are determined; and a route stage EA and public hearing by which the exact routing of the facilities is determined.
4) The environmental study methodologies were essentially the same in both studies. Starting with a study area defined by the plan stage studies, the methodology enabled the identification of a recommended route through a systematic narrowing of attention from study area to corridors to specific alternative rights-of-way.

   Both route studies also proceeded in four key steps:

   (i) scope and data collection at a scale of 1:50 000;
   (ii) determine environmental situations, rank and map environmental constraints, identify corridors;
   (iii) collect data at a scale of 1:15 000 within corridors, identify alternative routes; and
   (iv) evaluate and compare alternative routes and determine preferred route.

Both studies incorporated comprehensive public involvement programs with common objectives which attempted to:

(i) provide information to potentially affected or interested publics on all aspects of the study;
(ii) establish and maintain effective two-way communication with the public;
(iii) provide opportunities for public contributions to the study; and
(iv) identify issues related to the project early and resolve those issues where possible.

The Public Involvement Program - Bruce to Essa

The Bruce to Essa study area includes portions of four counties, some 30 townships, and stretches about 150 km from the Bruce Nuclear Power Development on the shores of Lake Huron to the Essa Transformer station near

Barrie. This part of Ontario contains some of the most distinctive and scenic landscapes in the southern half of the province, found along the Niagara Escarpment. Many recreational activities such as hiking, cross-country and downhill skiing are associated with the large blocks of forest and steep escarpment slopes throughout the central and eastern portions of the study area.

The public involvement program was initiated in the fall of 1982 to involve the public in all phases of the study. A joint planning component of the program consisted of two public working groups which met with the Ontario Hydro planning team on a regular basis throughout the year long study.. These groups reviewed Hydro's data, offered local information, and contributed community preferences. An information component of the program took detailed project information to the public, most importantly the potentially affected property owners, at the four key stages of the project. This was achieved principally through information centres, newsletter mailings, advertising, and presentations to municipal councils.

Information Centres

The information centres were the principal method used to exchange information with landowners. Held at the four key steps of the study, they consisted of one-day information displays and maps set up in community halls and staffed by up to a dozen members of the project team. The times and locations of the centres were advertised in the local media and a project newsletter was mailed prior to each series of centres. Public attendance at the centres is shown in Table 1.

TABLE 1 BRUCE TO ESSA INFORMATION CENTRES

	Subject	Date	Locations	Attendance	Range	Avg.
1	Introduction	Nov. 82	8	485	30-100	61
2	Corridors	June 83	13	795	25-150	61
3	Alternative Routes	Aug. 83	13	1890	75-400	145
4	Recommendation	Dec. 83	13	445	15-75	34

The first two series of centres proceeded smoothly. With an average of almost 60 visitors over a 5 hour period, everyone had an opportunity to speak with a member of the project team, locate their property on maps, and register their concerns. The third series of centres, when the greatest number of properties were affected by alternative routes, was a different story. With over 200 visitors at three of the centres and an average per centre of about 150, the common mood was one of anger and frustration: anger at being affected by one of the routes on the map that Hydro had mailed to them; and frustration at the inability of the team members present to deal with each of them personally. At the one centre with 400 visitors, the project staff abandoned the objective of one-on-one relationships and addressed the group in a public meeting format, by making a presentation and then responding to questions.

By the final series of centres, the numbers were more manageable and the interaction with property owners was more productive. By then, however, there were legal actions being initiated in the community which made residents somewhat indifferent to Hydro's information centres. This problem is elaborated in the next section.

Working Groups

The working groups were intended to provide the forum for the project team to plan for the facilities together with representatives of the community. A summary of working group representation is provided in Table 2.

TABLE 2 BRUCE TO ESSA WORKING GROUPS

Organization	West Working Group	East Working Group
Municipal Governments	15	20
Conservation Authorities	2	2
Agricultural	8	12
Community/Cultural	2	2
Industry	1	2
Environmental	2	4
Recreational	2	4
Ministries	3	3
Total Appointed	35	49

The notes of the working group meetings were recorded by independent notetakers, and were included in the reference material filed with the Environmental Assessment.

A schedule of twelve joint planning meetings was initially scheduled. This increased to as many as sixteen meetings before the program concluded. The subjects and dates of the meetings are shown in Table 3.

TABLE 3 BRUCE TO ESSA WORKING GROUP MEETINGS

	TOPICS	DATE
1	Introduction and Public Concerns	Nov. 82
2,3,4,5	Review Environmental Method and Data	Dec. 82-Feb. 83
6	Develop Environmental Objectives	Mar. 83
7	Rate Environmental Objectives	Apr. 83
	Corridor Identification (Subcommittee)	Apr. 83
8	Corridors Reviewed	Apr. 83
Optional	"Property Compensation"	June 83
9	Review corridor data Review route ID criteria	June 83
10	Review preliminary routes	Aug. 83
Optional	"Need for the Facilities"	Aug. 83
11	Review preliminary routes	Sept. 83
12	Review evaluations and compare routes	Oct. 83
13	Compare alternative routes	Oct. 83
14	Recommend Route	Nov. 83

The first part of the program proceeded smoothly. The two groups were larger than ideal, but the study team felt the benefits of township representation justified the problems of dealing with such numbers in working meetings. The issue of need, and Hydro's authority to proceed with the route study, was the principal concern expressed at the meetings.

As noted above, this study was the second stage of a two stage environmental assessment and public hearings process. The problem the public representatives found difficult was that Hydro had not recommended the Bruce to Essa line in its plan stage studies. It was an <u>alternative</u> that was identified, but it was not Hydro's first choice. The Joint Board, however, after public hearings, rejected Hydro's recommendation and approved the Bruce to Essa alternative. The Bruce to Essa community was upset by this decision of the Board. The community had not been well represented at the plan stage hearings on the assumption that Hydro's recommendation, one that did not affect them, would carry the day. This two stage approvals process was new and there was a general impression that they were the victims of a process that was not understood.

These feelings were an underlying current with the working groups through their first nine meetings, though it did not prevent the groups from reviewing the environmental data, ranking environmental objectives of areas to avoid, and participating in the delineation of corridors.

The community became more generally aware of the study in the summer of 1983 when Hydro mailed some 5000 letters showing alternative routes, and by August, pressures were being felt by the study team and members of the working groups. On August 2, a working group meeting intended to review the alternative routes was not able to complete its agenda because of the presence of 200 angry and vocal spectators. At subsequent meetings in August, over 400 attended a presentation on the need for the project and saw university professors, doctors, lawyers, and a Senator of the Government of Canada make impassioned pleas, before the cameras of a national TV network, that Hydro should not be allowed to "rape the natural environment of the Niagara Escarpment".

As a result, the value of the working group meetings diminished significantly after August 1. Politicians on the groups were silenced by their constituents and chose not to contribute to the process. The working group meetings were used by the property owners as rallying points for their rhetoric and fund-raising. The study team marched off to each meeting wondering why they needed to go through the motions.

The end result of the ground swell of opposition was an application before the Divisional Court of Ontario in January 1984 to nullify the Plan Stage hearing that decided upon the Plan that included a Bruce to Essa route. The argument was that the Notice for the hearings did not properly describe what was at risk at the public hearings. The court agreed. The plan stage decision was nullified and Hydro is only now ready, after two years of further study, to take its environmental assessment before a new public hearing.

The Public Involvement Program - Lennox to Ottawa

The Lennox to Ottawa study area is approximately the same size as the Bruce to Essa study area, with about 180 km between the two end points for the lines. A similar number of municipalities are included in the study area and like Bruce to Essa, the two significant land uses are agriculture and recreation. Recreational activities are a principal land use along the lakes and rugged landscapes of the Canadian Shield, which dominates the central portion of the study area. There are strong historical links, associated with settlement in the area by United Empire Loyalists, the cities of Kingston and Ottawa at each end of the study area and the Rideau Canal which joins them.

The Eastern Ontario study's public involvement program had similar information and joint planning components but there were significant differences in the approach to the working groups and the information centres. In the Bruce to Essa study the approach used to involve the local municipalities was to invite them to appoint political representatives on the working groups. In the Eastern Ontario study, a regional advisory group was formed to assist in locating corridors by providing an overview of the issues and concerns related to locating transmission lines. The members were requested to:

1) advise on the importance of environmental criteria used to identify alternative corridors;
2) act as liaison between the project team and their parent organizations; and
3) review and comment on Hydro's key decisions throughout the study.

Criteria for invitations were set as follows: members were representatives of provincial or federal agencies, regional interest groups, municipalities or the private sector with an interest in the study, able to attend approximately 5 meetings over 12 months.

A single 30 member group was formed and met six times over the year long study, starting in November 1982.

The membership is compared with that of the Bruce to Essa group in Table 4; it can be seen there is considerably less reliance on political representation. The municipalities included were from the county level, and for the most part they were staff on planning boards as opposed to members of municipal councils.

TABLE 4 EASTERN AND SOUTHWESTERN ONTARIO WORKING GROUP REPRESENTATION

Organization	Bruce to Essa West Group	Bruce to Essa East Group	Lennox to Ottawa
Municipal Governments	15	20	8
Conservation Authorities	2	2	1
Agricultural	8	12	5
Community/Cultural	2	2	3
Industry and Resource	1	2	2
Environmental	2	4	3
Recreational	2	4	2
Ministries	3	3	5
Total	35	49	29

The other major difference was the scope of the meeting schedule. While 14 or 16 meetings took place for the Bruce to Essa groups, the Eastern Ontario team planned five meetings and actually met six times. The subjects of the meetings are shown in Table 5. All of these meetings were orderly and the group was generally satisfied with the level of detail provided by the study team.

TABLE 5 LENNOX TO OTTAWA REGIONAL COMMITTEE MEETINGS

Meeting	Topics	Date
1	Introductory, terms of reference	Nov. 82
2	Rating of Corridor Location Criteria	Dec. 82
3	Review Corridors	Mar. 83
4	Review Public Response to Corridors	June 83
5	Review Alternative Routes	Oct. 83
6	Present Rationale for Route Recommendation	June 84

The other significant difference in the program was the approach to information centres. The regional committees' principal contributions were in the early phases of the study leading to the identification of corridors through the study area. Their major input was at meeting number two, the rating of environmental criteria. Once corridors were mapped the study team turned their attention to property owners and the local municipalities. This was done through three series of information centres, each series consisting of 24 or 25 one-day centres. This is about twice the number used in the Bruce to Essa study.

The greater number of centres is the result of organization on a township basis. In fact, the objective of the approach was to sponsor the centres in partnership with the local township councils. Township councils were consulted on the idea at the beginning of the study and for the most part agreed with the approach. As townships knew they would be involved when there were corridors on the maps, they did not see the need to be involved on the regional advisory committee.

With this very local emphasis on the program at corridor and alternative route stages, the study team used a different label of the one-day information centres or open houses. They called the centres "Municipal Participation Centres" (MPC), thereby emphasizing the co-sponsorship of the centres with the municipality and the involvement or information exchange that was anticipated.

The MPC's worked better in some townships than others, but generally it was a successful program. There was an interesting pattern of attendance at the centres (see Table 6). Typically, as exemplified in the Bruce to Essa example, our experience is that interest and attendance peaks when alternative routes are presented. In this case, the interest was greatest at the beginning and attendance declined through the three series of centres. This may be attributed to the success of the study team in explaining the study and addressing and responding to the issues and concerns of the MPC visitors. (However, the addition of an "introductory" series of centres, as in the Bruce to Essa study, might have resulted in the more typical distribution.)

This study has now concluded. The public program was part of the documentation submitted in the Environmental Assessment late in the summer of 1984. Public hearings took place last winter and while the decision of the approvals board was delayed due to a stated case before the courts this past summer, the Reasons for Decision of the Joint Board were received on September 30, 1985. Hydro's recommendation was accepted by the Joint Board

TABLE 6 LENNOX TO OTTAWA MUNICIPAL PARTICIPATION CENTRES

	Subject	Date	Location	Attendance	Avg.
1	Corridors	Mar. 83	25	2220	89
2	Alternative Routes	Nov. 83	24	1700	71
3	Recommendation	May 84	24	780	33

with minor modifications and conditions. Property acquisitions are planned to begin in 1986.

Conclusion

While the Lennox to Ottawa study proceeded smoothly through to Public Hearings and a favourable approval decision and the Bruce to Essa study did not, the explanation cannot just be attributed to the differences in the public involvement program. In the Bruce to Essa study, the need for the line was based on what became an invalid public hearing which approved a plan not recommended by Hydro. Opposition increased throughout the route stage study putting severe pressures on the public involvement mechanisms. In the Lennox to Ottawa study, the need for the lines was based on a valid approvals process which agreed with Hydro's recommendation. Opposition on the "need" arguments diminished over the course of the study to the point where the principal critic of the need for the facilities at the Plan stage public hearings did not attend the public hearing at the route stage.

While Hydro does not have the benefit of an evaluation from the participants' point of view, some personal observations can be offered:

1. The reasons why the public programs for such similar projects were so different are twofold: the publics were different; and the study teams brought different experiences and personal objectives to the studies.

   Through the experience of the past decade, an inventory of proven public involvement techniques has accumulated. But there is no such thing as a standard public involvement program. Each program is uniquely molded to reflect the technical nature of the study and the nature of the affected and interested publics. And just as the differing publics determine the program, so do the study team members contribute to the design and success of a program from their own particular objectives and experiences.

2. A couple of further observations on these points. First, know your publics, and get to know them before decisions are made about the public program. Scoping or community profiling in advance of program design is essential so that social data, the views of community leaders and development histories can be taken into consideration. Secondly, ensure that decisions on program design are based on the social data and the organization's collective experiences. There can be too much emphasis on the predispositions of study team members.
3. "Public Involvement" should not be equated with "Joint Planning". A very successful public program can be very different from a joint decision-making process.
4. When joint planning is a program objective, it can be accomplished without a course in land use planning. The Bruce to Essa study took seven meetings to take the public members to the principal product of the exercise, the rating of environmental priorities. The Lennox to Ottawa study reached the same objective in two meetings.
5. When using citizen committees, keep the group size manageable. Twenty or fewer works best. Where the criteria for group membership results in larger groups, consider more than one group, and also consider a more limiting membership criteria.
6. When dealing with public groups and committees, be as explicit as possible with the terms of reference. The public needs to know and agree with what's expected of them in order to be comfortable and effective. Explicit terms of reference also help to ensure that there are no false or unreasonable expectations among study team members or management.
7. Our recent experience is indicating that politicians are best dealt with at arm's length. They need to be kept informed, and they greatly appreciate the courtesy if the information is provided in advance of public distribution. But they don't need to be representatives on public committees. The few that want to be involved can be accommodated but most will be satisfied if involvement opportunities are available to their constituents. The danger in drawing them too close to the planning process is that they lose their objectivity and the process can become politicized. It's best to leave the

politics to the council chambers and include non-elected representatives on the planning committee.

8. Information Centres and Municipal Participation Centres are the same thing going by different names. As far as the public visitors were concerned, they were just going to "the Hydro meeting". However, in attempting to make the name more reflective of what was expected to happen, the study team was heading in the right direction. The concept of cosponsorship of the centres with municipalities was welcomed by some and ignored by others. Cosponsorship does, however, involve a risk of less control of the information centre by the study team. In some cases the municipality requested a public meeting question-answer format. Although Hydro has found that a public meeting is not a productive format, we were reluctant to decline these requests when made by a cosponsor of the event.

9. Finally, these major programs have continued to underline the importance of personal field contacts. Meetings in the field with individuals, whether property owners, interest group members, or politicians, are valuable in terms of the personal presence that is given to the corporation and to the information exchange opportunities that are provided. While extensive and regular personal contacts are a challenge to the resourcing and documentation aspects of a project, they simply cannot be replaced by gatherings of representatives in committees and workshops. Too much of what could be gained and offered face-to-face can be lost or suppressed in a group environment.

AN ANALYSIS OF PUBLIC INVOLVEMENT IN ENVIRONMENTAL DECISION MAKING

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Introduction

In this paper, the development of public consultation and environmental impact assessment in British Columbia is examined. Although that province has made major advances in both areas over the last decade, the two have not always complemented each other in assessments of major projects. Based on two case examples, one involving a hydro-electric dam and the other a coal mine, the role and utility of public consultation in project assessment is analysed. The usefulness of the approaches taken is evaluated in terms of meeting the objectives of the various interests involved. Finally, some general observations about public involvement in environmental impact assessment are made.

Environmental Impact Assessment and Public Consultation in British Columbia

Environmental Impact Assessment

The use of environmental impact assessment in project evaluation began in a rudimentary form as early as 1967 in B.C. (and perhaps earlier). It was in that year that the provincial government created the Environment and Land Use Committee (ELUC) -- a cabinet committee designed to resolve land use conflicts. ELUC relied on various agencies' review of a potential conflict before coming to a decision.

With the election of an NDP government in 1972, a secretariat was added to ELUC to:

i) design a systematic approach to evaluation resource projects; and
ii) provide the Cabinet Committee with an independent assessment of a conflict so that the Agency with the most clout would not always win out.

During the time of the secretariat's existence, guidelines for cost benefit analysis and the assessment of coal mines, linear projects, and mitigation and compensation, were all developed to allow a uniform approach to project assessment. A sophisticated interagency review system for major projects, which continues to be used despite the dismantling of the secretariat in 1980, was also developed.

Public or interest consultation played little or no role in the environmental impact assessment process established by the secretariat, although a proponent was generally required to make some effort to provide information about the project in the impact area.

There are probably a number of reasons why this occurred:

1) In many cases, proponents and their consultants develop a comfortable relationship with reviewing agencies; in that situation, interest groups might be viewed as unwelcome third parties.
2) Public involvement at any stage of review would require extra staff time and energy, already fully committed under existing work loads.
3) Consultation with interest groups, and particularly public hearings, carried with it the risk of embarrassment or at least a high profile, which would upset the proponent and also the political people to whom the secretariat was answerable. It is not unlikely that many of the agencies with which the secretariat worked had philosophical problems with environmental impact assessment, let alone public consultation.
4) The secretariat felt it had the in-house resources or could hire the expertise to properly assess all impacts of a project.
5) Finally, a public hearing would mean a delegation of decision-making power to an unknown quantity.

Public Consultation

For many of the reasons mentioned above, politicians in B.C. were also not too interested in public consultation. Unlike their employees, however, they also had to deal with an electorate where there was broad support for environmental protection and with individuals and groups who were increasingly vocal about their right to be consulted when their interests would be affected.

This pressure was particularly intense where energy projects, such as hydro-electric dams, were involved. These projects generally affected a cross section of interests because they were located in valley bottoms where land use conflict was heightened. In a province which is largely mountainous, valleys represent the best locations for settlement, agriculture and forestry. Flooding represented a single use which upset all other potential users.

The end result was the B.C. Utilities Commission Act, introduced in 1980, which allowed for public evaluation of major energy projects before Cabinet made the final decision.

However, no legislation has been introduced by the B.C. Government to allow public hearings in any other type of environmental impact assessment.

Two Case Studies

The following case studies focus on public involvement in environmental impact assessment rather than the management stages of a project. Little opportunity has been provided for public input in the latter. As well, most interest groups have tended to focus on the policy aspects of project development, such as whether or not the project should actually be built, rather than on specific proposals for mitigation and compensation.

The following cases involve major projects in B.C. where there was interest conflict, substantial environmental impact assessments prepared and public hearings to air the issues involved. However, the success of the process was radically different both in terms of the satisfaction felt by those involved and the information which was ultimately provided to decision makers.

Site C

Background

Site C was (and is) a $3 billion hydro-electric project proposed by the B.C. Hydro and Power Authority for the Peace River in northeastern B.C. Its location, in the idyllic Peace Valley, has generated controversy ever since plans for the development were announced in 1976.

The major environmental and socio-economic issues included:

1) destruction of 8 - 10 000 acres of high quality farmland (with a climate that was unique in the region);
2) destruction of valuable overwintering habitat for moose and deer; and
3) disruption of hunting and trapping rights of Treaty 8 Indian bands.

In preparing the application for the project, B.C. Hydro hired consultants to produce an environmental impact assessment. In commissioning these studies, B.C. Hydro had direction from an intergovernmental committee but little or no input from the interest groups that would be affected.

The Hearing Process

The evidence prepared by B.C. Hydro and the direction provided by the interagency review did not anticipate full public hearings. The last major hydro-electric project had undergone a brief public hearing. However, this had occurred under the B.C. Water Act with narrow terms of reference. The hearing was conducted under the auspices of the Water Comptroller, and he, as well as the interest groups appearing before him, were ill-prepared to tackle the environmental impact assessment prepared by B.C. Hydro.

The hearings established under the newly created B.C. Utilities Commission Act were in a completely different category and this time it was B.C. Hydro and government agencies which were caught off guard. The Act enabled the preparation of broad terms of reference for the hearings, including an assessment of the benefits and costs of the project; and allowed cost awards for intervenors. As well, the Chairman of the Panel was committed to a fair and open process. He ensured, in particular, adequate time to prepare and present evidence, a thorough review of government policy, and that the Panel had independent advice from consultants which they hired directly.

Although intervenors had concerns about the perspectives of members of the review panel, as well as the way in which costs were being awarded (which required that they hire consultants on a contingency basis), all participated to the best of their ability and resources.

Involved throughout the entire formal hearings were organizations such as the Peace Valley Environmental Association (PVEA) representing 500 farmers, teachers, civil servants and other residents of the Peace Valley, the Treaty 8 Tribal Association representing local Indian bands and SPEC, an energy conservation organization with province-wide membership. The majority of intervenors only participated in specific phases of the Hearings. For example, the B.C. Federation of Agriculture, B.C. Institute of Agrologists and the National Farmers Union, all cross-examined and presented evidence on the agricultural impacts of the Project. In all, over 60 individuals and organizations made formal interventions at the Hearings. Many more participated in the community hearings set up by the Panel.

Much of the evidence presented by these interest groups related to impacts that they would suffer personally, i.e., it was information that the Panel could not have obtained from any other source. For example, the Treaty 8 Tribal Association presented extensive evidence on the importance of the moose which would be destroyed by the project to the diets of Indian bands in the Peace Region. B.C. Hydro had virtually ignored this factor in its Environmental Impact Assessment.

Agricultural experts from across Canada were called by the PVEA, the B.C. Institute of Agrologists, the B.C. Federation of Agriculture and the National Farmers Union to put the loss of the Peace Valley lands in a regional, provincial, national and international perspective. B.C. Hydro's agricultural consultant did not address this issue, nor is it surprising that he did not attempt to do so.

In its decision, the Panel made the following comments about public involvement:

> The primary purpose of the hearing is not to provide a forum for participants to persuade the public to their point of view, but to allow the Commission to hear evidence and argument. In addition, it provides an outlet for the frustrations that have built up over the years about the openness, fairness and adequacy of public participation in decision-making on major energy projects. The Site C Panel concludes that this process is worthwhile.

The Panel also found that the award of costs to intervenors "contributed to a fair and comprehensive review process" and concluded that full public hearings should be held for all major energy projects.

Perhaps the most significant contribution made by the public hearing process was the Panel's recommendation that there was no justification for Site C at that time (1983) and that B.C. Hydro would have to show that the project would result in a net benefit before it should be approved. The net result was that an unneeded $3 billion project was not built and it later became common wisdom that it would have been a financial disaster to have been constructed at the time B.C. Hydro wanted to go ahead (in 1981).

The Panel also made detailed recommendations regarding mitigation and compensation for the project, should B.C. Hydro be able to demonstrate justification for Site C. These recommendations were far more sophisticated than what could have been proposed by an intergovernmental review, in that:

1) all interests were reflected in the proposals;
2) the actual public and private costs of the project could be identified in a clear and accountable way; and
3) a mechanism was developed to allow continued public involvement in monitoring the impacts of the project and providing appropriate mitigation measures as construction and operation proceeded.

The Panel's report made many recommendations about the way in which the hearing process (which took more than one year) could be streamlined. As this was the first attempt in B.C. to have comprehensive public hearings in conjunction with an environmental impact assessment, it was not surprising that there would be a number of bugs to iron out. In addition, the Hearings were delayed by:

1) B.C. Hydro information which was several years out of date;
2) information produced by the proponent which did not reflect many of the issues which were of paramount concern to interests which would be affected by the project; and
3) government agencies which changed their minds several times about participating in the Hearings, thus delaying the start-up by three weeks and producing information which had to be significantly revised during the course of the Hearings.

Despite the Panel's support for public hearings and the positive results obtained, the provincial government made it clear that it was dissatisfied with the process, and in particular, with the amount of time that had been taken to complete the hearings. The Government took several steps to ensure that there would never again be a process like the Site C Hearings. It removed the cost provision from the B.C. Utilities Commission Act; it stopped referring any project reviews or energy matters (apart from rate-setting) to the Utilities Commission; and, finally, all future project reviews were done under narrow terms of reference, with a limited time period for public preparation and participation.

The next case study is an example of the kind of hearing which resulted.

Quinsam Coal

The second case study involves a coal mine proposed for development adjacent to an important salmon spawning river on Vancouver Island. The river flows through Campbell River, a town dependent on tourists who are attracted to the salmon fishing in the area. As well, there is a major salmon hatchery on the river.

As a result of the potential impacts on tourism, many residents of the area were opposed to the mine - particularly since another mine had already destroyed the fish in the region's other major salmon river.

As discussed earlier, no process exists for public consultation where a mine is proposed. Projects are assessed in a three stage process coordinated by an interministerial group under the Ministry of Mines. In Stage 1, a proponent must file a feasibility study and preliminary assessment of expected impacts from the project. In Stage 2, a detailed environmental impact assessment is prepared. A proponent must receive approval in principle from the Environment and Land Use Committee (Cabinet Committee) at the end of that stage before proceeding to licencing in Stage 3.

The proponent is responsible for holding an information meeting during Phase 2; however no public review of the proposal is possible until after approval-in-principle at the end of Stage 2. When a proponent applies for waste management permits in Stage 3, appeals to a tribunal are possible by the public; however, they are limited to the narrow issue of whether the permits have been properly issued.

Interest groups in Campbell River lobbied the provincial government to hold public hearings before it decided whether to give Quinsam Coal approval at the end of Stage 2. This request was consistently refused until the Federal Department of Fisheries made it clear that they considered public hearings were a good idea and a condition of their support of the project.

As a result of federal pressure, the Cabinet came up with a compromise that satisfied no one: they ordered approval-in-principle with the condition that a public hearing be held. It was difficult for interest groups (and other parties) not to be cynical about a process where the final outcome had already been decided.

The hearing process itself did nothing to restore confidence. No intervenor funding was provided, making it impossible for anyone other than the company to provide technical information. Staff with the various provincial ministries did not have the training to assess the adequacy of information provided by company consultants.

In addition, the company filed all of the detailed information relating to the mine's waste management system less than a week before the commencement of the hearings, catching both interest groups and the Department of Fisheries off guard. The Board presiding over the hearings refused to grant any adjournments.

The result of the process was intense public dissatisfaction with the outcome; it did not generate any information which could assist in planning the project -- nor was it intended to do so.

Analysis

A public consultation catastrophe, such as the Quinsam Coal Mine Hearings, is likely to be held up as justification for the position that involvement of various interests in the decision-making process is a waste of time. With the Quinsam mine, decision-makers had not interest in public consultation; the political decision to proceed with the mine had already been made. Hearings were set up only in response to public and Federal Government pressure rather than in response to a desire for policy input. The result was a process which gave those participating no hope and no opportunity of ultimately affecting the decision that was going to be made. Not only were interest groups unable to prepare and present information which would have assisted the review of the mine proposal, they were also not motivated to participate in a process where they would have little impact.

By contrast, the Site C Hearings attracted thorough and considered interventions by a wide range of interests and as a result produced recommendations which could not have been otherwise generated. Moreover, the experience gained with these hearings would ensure that future energy project reviews could be conducted in a much shorter period of time. A full-scale hearing is not required in every situation.

The decision to hold public hearings is a political one and will vary with every situation, depending on such factors as the degree to which policy decisions have already been made, the interests that will be affected and the attitudes of the public service. It is my opinion that public involvement is appropriate wherever there is a resource use conflict. There is no magic formula for the involvement of various interests in the evaluation of major projects. For example, public hearings allow:

1) identification of interests that will be affected by a project and the degree of impact that will be felt;
2) determination of mechanisms for minimizing the impacts that will occur;

3) a context in which to evaluate risks from a project (e.g., the chance that a blowout will occur from offshore exploration) or to evaluate various policy options; and
4) public satisfaction rather than anger with the political decision that is ultimately made.

However, the case studies suggest that the following elements must be present to ensure that the hearing process is not a waste of time for all concerned:

1) a clear opportunity of affecting the ultimate decision in areas which are of concern to those participating (this can be reflected by terms of reference, those chosen to conduct public hearings, timing of public consultation, etc.);
2) a right to prepare information through funding or cost awards; and
3) adequate time to prepare for and to participate in the hearings.

In summary, public involvement can be an effective means to identify interests which will be affected by a major project, to assess the options which exist and to evaluate risks that may be involved. The political interest in seeking this input will depend on the degree to which policy decisions have already been made and the attitude to involving interests other than a proponent. Where public involvement is the result of demand to hold a hearing, this will be reflected in the process which is established and will affect the seriousness with which it is treated by interest groups. By contrast, public consultation which has as its goal the resolution of conflicts and which has the earmarks of fairness about it will be treated with respect by those who participate. It will also ultimately provide those who must make the decision with the information they require -- with the added bonus of public satisfaction with the final result.

A CRITICAL REVIEW OF COMMUNITY PARTICIPATION IN THE NORTHERN OIL AND GAS ACTION PROGRAM, SOCIAL SERVICES DATA BASE STUDY

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Introduction

The following paper critically examines the efforts of the Department of Social Services to include community participation in the implementation of a data base study. The major component of the project was based in Inuvik and involved seven communities fringing the Beaufort Sea. The project was funded by the Northern Oil and Gas Action Program of the federal government to plan for the eventual production and transportation of hydrocarbon products in the area.

The paper provides a background to orientate the reader to the development of the project. A brief review of the theoretical background of community participation in social impact assessment and research summarizes the importance of community involvement and some of the difficulties in achieving that end. A short description of the efforts made to involve community input and its success and frustrations is presented followed by an analysis and a discussion explaining the difficulties in developing and sustaining community involvement. Finally the paper concludes with a series of recommendations which may be helpful for those planning future research projects.

Background

During the late seventies, the federal government recognized the need for a comprehensive evaluation of the Beaufort/Delta area. Utilizing grants from the Department of Energy, Mines and Resources, the oil industry had embarked on a major hydrocarbon exploration program. The situation appeared to be gearing up for eventual production and transportation of hydrocarbon products. The government responded with two thrusts to address the rapid change that was occurring and expected to continue in the area.

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* The views and opinions expressed in this paper are those of the author and do not necessarily reflect those of the Government of the Northwest Territories.

Under the Environmental Assessment Review Process (EARP), the Beaufort Environmental Assessment Review Panel (BEARP) was formed in July 1980. Panel Chairman, J.S. Tener along with six northern and technical experts embarked on extensive travel in order to complete the review. The panel's report was released in July 1984.

The federal government's second major response was to initiate the Northern Oil and Gas Action Program (NOGAP) through the Department of Indian and Northern Affairs. This research and planning program was implemented to improve the federal and territorial governments' preparedness for hydrocarbon development and production north of the sixth parallel by the year 1991.

Government preparedness refers generally to:

> acquiring the knowledge and analytical capability to make appropriate decisions concerning major northern hydrocarbon development proposals. Preparedness requires the ability to evaluate environmental impacts and mitigate adverse ones; to develop guidelines and techniques to minimize hazards; to plan for public services and infrastructure increases, and to implement means of enhancing northern opportunities and benefits from hydrocarbon development (NOGAP Secretariat, 1985).

In September 1982, $6.8 million was approved by Cabinet for the 1982-83 fiscal year. In February 1984, the program was replanned to reflect a 43 percent decrease in expenditures that total $134 million to be operated over seven years to 1991. Seven federal departments and the governments of the Yukon and the Northwest Territories participate in this program.

The Department of Social Services, GNWT, received substantial funding in order to implement a baseline data study on social impacts in the Beaufort/Delta area. The department recognized the need for valid and reliable social data that could be used by the department, governments, industry and communities to ameliorate negative impacts and enhance positive benefits. The project would determine the changing social dimensions of the impacted communities and assist in the department's ability to respond. From these data, the department and others utilizing the information could develop appropriate strategies to respond to the community needs. The information would enable each community to identify, prioritize and respond with their own community programs.

The project was developed in order to respond to anticipated future research and planning requirements. Special projects focussing on specific information needs can be developed as the data gaps become identified. Specialized studies have already been completed on the child care needs of the communities and the training needs of department social workers. Currently, a study is being planned to examine the effects of rotational and wage employment on families and on the effects of increased substance abuse.

The major project based in Inuvik is the development and implementation of a Data Base System. The project was developed to collect, compile and present social data from a variety of sources. Building from previous work by Carley (1984), the project has identified and critiqued all available indicators and examined and summarized the important community concerns and issues. A recent publication presents the results of the first year's work (Durst, 1985).

The subject of this paper, a community-based steering committee, was formed in the early developments of the project. Community leaders and interested residents were invited to participate. Some of the members were representatives of community or native organizations such as hamlet or band councils. The committee was to provide input on the selection, collection and analysis of the data. They also assisted in identifying further research and planning needs. It is the functioning of this committee that this paper examines.

Theoretical Background

For all the literature that has focussed on social impact assessment and research, surprisingly little deals with the participation of the impacted community. As Cooper (1981, 338) stated, "implicited in almost all discussions of social impact analysis is the importance of the 'impactee'". Yet he also notes the community and its residents are often forgotten as the researchers become "caught up in discussion of the mechanics of conducting studies or the politics of pursuing the results".

This raises a central point: how does one define participation in the social impact field? Lee (1984) made some important distinctions. An impact study can be implemented through two dichotomous "democracies". The study can be implemented by technical managers who are accountable to senior bureaucrats who in turn answer to an elected official acting as a minister. The minister answers to the general public as their elected representative. Based upon their expertise, the technical managers make the major decisions since they are acting as agents of "representative democracy". On the other hand, "participatory democracy" would see the researchers share the decision-making process and work in cooperation with the community as technical advisors.

A major obstacle to effective community participation is the profession of social impact research itself. Grown out of an academic field, social impact study has focused primarily on the quantification, forecasting and analysis of so-called objective statistics. The role of the "impactee" and their participation in the selection, interpretation and analysis of both quantitative and qualitative data has frequently been ignored.

Part of the reason for this development can be explained by examining the developmental roots of social impact research. Social impact methodology has grown out of the two distinct philosophical approaches (Lee, 1984). The first impact research studies have come from disciplines that emphasized an objective scientific approach such as sociology, social geography, economics, political science and psychology. This contrasts with those who have taken an "interactive problem solving" approach such as social work, community development, anthropology, and urban planning.

Tester and Mykes (1981) and Torgerson (1980) were among the first social impact researchers to identify the polarization of the field. In general, Canadian social impact researchers have been quicker than their American counterparts in identifying this trend.

The "social sciences or product" approach predominantly utilizes social indicators to describe and quantify social conditions. The collection of data is used by decision-makers to ameliorate negative impacts and maximize positive benefits. It is mainly a centralized technical process that excludes the input and participation of the lay resident.

The "planning or process" approach involves the residents in the planning of the study. The identification and collection of both qualitative and quantitative data are shared with the community. The community also shares the analysis and interpretation of the data and provides the research a community perspective. Better informed, the community can take a greater role in decision-making. This approach encourages the decentralization of decision-making, local participation and the qualitative subjective aspects of community data.

Early work by Wood (1974) and Palmer and St. Pierre (1974) discussed an indicator approach in the northern native context. It became obvious that indicators alone did not appropriately describe the social context. Blishen et al. (1979) extended Wood's work but avoided the transposing of an urban model or universal theory to the northern community. They drafted a methodology that integrated the subjective qualitative and normative quantitative data into a model that could be used for community comparisons. This involved community input to determine which data should be collected and what the data meant. Torgerson (1980) discussed the "problem of contextuality" and emphasized the need for community input especially in the native community. A recurring theme in the book, Indian SIA, was the importance of community participation in all aspects of social impact study (Geisler et al., 1982). It is generally acknowledged that the strict "product" approach is unacceptable to studies involving native communities. Any social impact monitoring project must not be diverted into a factory of so-called "objective facts" but attempt to provide an accurate assessment of how the community is responding to the impacts of development.

Cooper (1981, 343) stated adamantly that the impactee,

> must be involved in establishing the terms of reference of the study, defining study details, and approving the final content of the study. This extensive participation is critical if the interests of those being studied are to be protected.

One of the first steps in effective social impact monitoring is the recognition of differing and sometimes conflicting interests from the various "players". In the Beaufort/Delta study, there are three main "players" and within each group are several subgroups. The hydrocarbon industry is frequently viewed as the "impacter" but development within the area has been occurring long before the arctic "oil patch" was discovered. Within the industry are the major players (the large exploration companies include Esso, Gulf and Dome) and small support industries such as supply shipping companies, seismic companies, suppliers and so on. Government is another major "players" that requires information from the monitoring project. There are three levels of governments involved: federal, territorial and municipal. The final "player" is the community which is comprised of individual residents who are involved in both traditional and modern life-styles. A group of quasi-governmental groups such as band council, native corporations and regional councils and committees exists between the government and the communities. The important point is that all the "players" have a vested interest in the production of an accurate and trustworthy monitoring data base from which they can draw information.

Lee (1984, 26) stated that the process or planning approach required that "the individuals must, in some way, represent all affected or interested community members, and must learn to think and negotiate collectively". This is not an easy task. Although traditional native culture emphasized collective sharing and mutual consensus decision-making, current trends are shifting towards a more individualistic and "majority rule" process.

Brizinski (1983, 39) saw community participation as a method of sharing information and knowledge within the power structure; and power is shared more equally "by getting input in earlier in the planning stage, by forcing consideration of alternatives, or by continual monitoring and reviewing of plans".

There are dangers involved in that the researcher may become trapped between conflicting values and goals between the major and minor "players". He/she could easily become defensive offering excuses or explanations for the activities or behaviour of one side or the other.

Research agencies may be reluctant to engage in joint participation on impact research. Brizinski (1983) summarized the literature and identified the following potential reasons for this reluctance. The agency may feel threatened by community input; believing that it will undermine their authority; will be too costly, and will produce extraneous data. The agency may also believe that the community lacks interest, that it will raise sensitive socio-political issues; and will make unreasonable or unrealistic demands.

These stumbling blocks can be overcome. The result will be a quality piece of work that will be trustworthy and useful from all perspectives. All players will be analyzing and planning from a mutual information base.

Application

The development of a regional steering committee was identified early in the project to be a crucial step in implementation. The committee was one method to ensure the participation of the communities of the Beaufort/Delta area.

In the fall of 1984, letters were sent to all of the settlement/hamlet councils briefly explaining the NOGAP project and requesting that they select a community representative to participate on the committee. The letter was sent by the Regional Superintendent of Social Services in Inuvik. Although the councils were familiar with the superintendent, no replies were received.

Similar letters were also mailed to the region's Developmental Impact Zone Society (DIZ Society) and Dene/Metis band offices. Again, no replies were received.

Although no formal interest was expressed, the letter served as an information sharing process, "word" was spread around about the project. In November 1984, social researchers travelled to the communities and interviewed various community people to identify the important community issues. They also identified interested people and informal invitations to participate on the committee meeting were made. The first steering committee was planned for November 23, 1984. All those interested were encouraged to attend and formal organizations were telephoned and invited to send a representative.

Six community residents attended the first meeting where overviews of the NOGAP studies were discussed. Soon key community concerns surfaced. The residents felt positive about the potential of the committee and confident that their contribution would play a major role in how the project develops.

It was after the committee had met twice that the actual terms of reference were developed. The objectives of the committee were twofold. They would provide input and participation in the direction of the project and equally important they would provide the communities with information regarding the objectives and activities of the project. The committee would participate in determining appropriate and meaningful indices and indicators. They would assist the researchers in identifying relevant qualitative and quantitative data in order that the data accurately reflect the perspective from the community. They were also to ensure that the project presents data in a form that is useful to the community in order for the community to respond to the changing social needs.

The committee agreed to meet after the researchers had collected some of the data and concerns they had identified. The next meetings were disappointments in terms of community participation. Only three members were able to make it and later meetings were met with requests to postpone. Data were presented and some discussion followed, but the next meetings were primarily instructive in nature. Little input was received from the committee although they did somewhat formalize themselves by selecting a chairperson. It seemed that the promise held at the first meeting petered out.

Analysis

Although the theorists espouse the benefits of active community participation, the actual application does present some serious difficulties and there exists limitations that tend to be overlooked. It is difficult to develop and sustain an active well-informed group of lay people to participate in a long-term impact study even though the participants are the impactees. Some of the reasons for this difficulty are listed below. Although these may not be universal, they may have relevance to other work.

1. The Committee was an ad hoc group not relating to any formally recognized organization, such as the Metis Association or the hamlet council. The committee was composed of interested lay residents recruited because of their respect and expertise at the community level. Some were appointed by municipal councils and the committee may not have been what was envisioned. As a result, the committee had no formal legitimacy. It has no accountability and no linkages to another formal body. It has no reporting relationship and therefore, from some points of view, it does not seem to matter if the committee exists or not.
2. Travel time was another hindrance to the committee's development. Travel is an unavoidable reality in the north as even a simple trip to the dentist frequently requires that the northerner leave home for a day or two. The committee became another meeting and another day away from home. For those living as far away as Coppermine, the flight arrangements are extremely inconvenient. The traveller must fly a thousand air kilometres south and overnight in Yellowknife before flying another thousand air kilometres north to Inuvik. Providing weather cooperates, the member would be required to be away from home six days to attend a two day meeting.

   With the membership of the committee being predominantly women, they frequently had the additional responsibility of arranging child care. Some brought their children along and arranged baby-sitting with friends and relatives. Since the members were already active community leaders, they were constantly in demand. Some complained about the frequency they were called away from home. For those who were required to overnight on their way to Inuvik, the burden was especially onerous.

3. The situation is further frustrated by the fact that some of the members have steady employment. With the general scarcity of regular and meaningful employment in the settlements, it becomes awkward and difficult for the members to request time off to attend these meetings. Remember, that these are the community leaders/experts who are already in demand and are frequently on several other worthy committees.
4. One of the realities of any community is that of limited personal resources. Each community, whether a block neighbourhood in ethnic Toronto or an arctic settlement, has only so many strong leaders with the experience and wisdom to integrate, analyze and interpret the contradictory and confusing social, political and economic dimensions of their community. There is a limited pool of community resource people to draw upon and they usually find themselves on the band council, hamlet council, recreation committee and so on. Once overextended, it is not uncommon for these highly-prized members to quit all their committees and retreat.
5. This steering committee seemed to be comprised of "like-minded" members. Effort was made to draw upon as broad a base as possible; people from different ethnic groups, life-styles and vocations were invited to participate. However, the committee seemed to be mainly middle aged women with native ancestry and who are active in the wage economy. Two of them were sisters. Most of them shared common opinions regarding crime, welfare, education, health and other social issues. It is not certain that these members fully reflect all of their communities' perspectives.
6. The topic of social impacts is not based upon simple cause-effect relationships. There are many subtle and abstract variables that confuse and complicate analysis. The committee members had considerable experience relating to the social dimensions of their settlements but little exposure to the analytic interpretation of their experiences. Many of the meetings slid into a teaching and developing session rather than an analytic brainstorming period. As Carniol _et al._ (1981) identified, some community residents are intimidated by a technical focus and this inhibits their willingness to

participate. This limitation was identified and every effort was made to facilitate their involvement and enhance their contribution.

Recommendations

Based upon our experiences to date, the following recommendations are suggested:

1. Establish honest and realistic objectives for the committee. Be clear about the level of participation that can be expected. For example, an advisory committee should be told that it is advice not supervision that is being sought.
2. Take a developmental approach and look for the long-term benefits rather than immediate results. The rewards may come slowly and not be obvious at first.
3. A citizen's committee will cost money. Be aware of what it will cost and budget appropriately.
4. In northern native communities, a formal approach with written letters to persons holding positions seldom works adequately. Visits to the communities and personal contact by the social researcher will assist in identifying important formal and informal leaders and potential participants.
5. It would legitimize the committee from the communities' perspective if it has some form of reporting relationships to a formal internal organization such as a band council. This would remove some of the ad hoc nature of the committee and place it into a defined role within the community. It would also make the committee more accountable in a more structured way to the community. It would then have a framework to report its findings. However, this also has some serious limitations. The committee could become an arm of a political group and lose its broader mandate to represent the community as a whole.
6. The social researchers need to avoid the "detached technocratic" image of many researchers. They need to act as a facilitator and sometimes a trainer to coach the committee through its early development. The researcher should be cautious not to overly identify himself with the community residents. The residents are quick to resent southern-raised and university

trained researchers who pretend to be "native". The researchers need to respect local heritage and culture but maintain their own background.

7. Relating to above, the researcher needs to develop credibility in the community. They need to live and work in the north to develop a mutual respect and trust. There exists quick resentment for southern "consultants" or "researchers" who fly through communities documenting "important data". Northerners like to place the researcher into a northern context. They like to know who they are, where they have worked and who they know. All of this takes time and successful consultants and researchers have hired local people or former northern residents to facilitate this process of building the researchers' credibility.
8. Effective committee development will require an emphasis on "training" and group process. The social researcher should have strong community development skills with a solid background in group work. The selective use of role playing and small group discussions in a relaxed informal setting will facilitate the conceptualization of some of the impacts and improve the committee's analytical abilities.
9. The researchers need to be prepared for the development of committee independence. As their confidence rises, they will demand a greater role in the direction of the project. They will not be satisfied with token input nor being used to "pass on" information to the communities. The researchers need to know exactly how far the funding source will permit community control. And, the researchers need to be straightforward and honest with the committee.

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THE CORPORATE BENEFIT OF PUBLIC INVOLVEMENT

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Introduction

Public involvement in facility siting used to raise visions of costly meetings and court battles precipitated by newly informed citizens. As agencies and utilities increased the amount and scope of public involvement, however, they may have been pleasantly surprised by the benefits, both to themselves and to the public.

Those benefits have been seen in projects of the Bonneville Power Administration (BPA) and identified in studies of the public involvement process (Ducsik and Austin, 1982, 102). When agencies and utilities are willing to share information, they seem less secretive, less suspicious. When they seek opinions and fairly consider them in the planning process, the public more readily accepts projects. When agencies and utilities spend money to hold a meeting and find new and vital information, they can build adjustments into planning and implementation of an environmentally and politically buildable project. And we create a better-informed public--a public less fearful, more understanding of the complex factors which enter into project decisions, and more willing to work closely with us in the future.

These benefits are commonly accepted among students of public involvement. They are even becoming more accepted by the technicians and decision-makers (McReynolds, 1984). What may not be as commonly perceived is what we call the "other benefit" of public involvement--the direct benefits to the agency or utility. In a special study of BPA's public involvement program, James Creighton (1984) stressed the point that public involvement makes for better decisions--a central goal of the U.S. National Environmental Policy Act (NEPA). This "other benefit" is not limited to endpoint decisions, but applies to decisions taken all through the project planning process. In fact, the integration of public involvement planning with project planning sharpens and focuses the project process for the project team. The project is more carefully defined; consequences are more efficiently anticipated; and a true set of choices, representing a full range of public values, is presented for the public and the decision-makers. The integration improves the predictive capability of environmental analysis and increases the potential for meeting the objectives of the planners through all stages of project development and implementation.

Changing Roles and Assumptions

The BPA Context

First, to illustrate the point, some context is necessary: our experience is based upon concrete developments at the Bonneville Power Administration (BPA). The BPA is a Federal electric power agency with a four-state service area in the U.S. Pacific Northwest. It is organized to reflect specific functions--the marketing of power to its utility and large industrial customers; the planning and building of transmission facilities; the operation and maintenance of those facilities; and the development of conservation as a resource. Because its service area covers a large territory, area offices are maintained to act as communication sources, as liaison with customers and the public, and as centers for maintenance activities.

For each transmission facility project at BPA, a project team is formed. It includes staff from each organization with some responsibility for the project. A typical team will include the system engineer as project team leader; a location and a design engineer; an environmental specialist; and the engineer from the area office in which the project is located. Staff from Land Acquisition or Substation Engineering may also participate. These key people exchange information, locate the line, design the structures, and lead the environmental studies. And it is they--because they know the most and <u>need</u> to know the most about the project--who best plan and carry out public involvement activities.

Governing Assumptions

BPA used to make the following assumptions about the facility planning process:

- Planning a major transmission project focuses on a single major decision point which legally determines whether, what, where, and how to build.

- The public would have some interest in major decisions.
- The technological expertise of those planning for and building the project is sufficient in itself to develop the best option in studies leading to the final decision.

However, a recent policy decision to institute integrated public involvement planning has caused us to rethink how we make major decisions on facility siting. New assumptions are now made about projects:

- Planning includes decisions made at all phases of a project. Multiple decisions occur before the final decision.
- The agency has an obligation to offer interested persons opportunities to contribute to all decisions which affect the public.
- The public has much to offer the agency in its planning process.

This change in assumptions occurred as the agency began to recognize that the endpoint decision (whether-and-where-to-build) is not a single event, but the focus of a series of intermediate and contributory decisions. At the same time, we began to realize that public contribution to that decision process was not only important but valuable to the agency as well as to the public. This meant public involvement in the early and intermediate decisions as well as in the final one. It also meant recognizing which decisions were technical ones and which involved value judgments and trade-offs (Bonneville Power Administration, 1985, 4.1-2).

Public Involvement: Consequences of the Old System

BPA projects are governed by a set of milestones to be met by each internal organization. However, under the old system, the environmental study was often begun with a need and a preliminary set of solutions already defined. The engineers' preferred alternative was often identified long before the environmental preference. So the respective studies often reached conclusions using different levels and kinds of information.

The agency usually involved the public through the legally mandated environmental process. Although other public contacts were often made, BPA recognized public input as relevant primarily to environmental review rather than to the project as a whole. As required by NEPA Regulations, the issues were conscientiously "scoped" as studies began, other agencies were involved by giving them preview copies of the study, and the public were asked to react to our conclusions and preferences when the draft study was published. Relatively little thought was given to when or what kinds of information the public could provide or to what information the agency should give them; or to evaluating whether we knew enough about the public's values to make intermediate decisions. BPA saw questions of siting, design, and systems alternatives as technical questions to be answered by technical people. The public, by contrast, saw those questions as posing choices among different values or priorities. Consequently, even when we went beyond the legal requirements for public involvement, we still encountered substantial opposition and often had to make major location or design changes at the eleventh hour.

Public Involvement: Consequences of the Change

As public involvement planning became an integral part of project planning, we began to define more clearly the sequence of steps leading to a decision:

- defining the problem, or need;
- defining a full range of alternatives;
- identifying and evaluating all possible consequences; and
- preferring one set of options and attendant consequences over another.

Public involvement objectives and strategies could then be keyed to each decision step.

BPA's Office of Engineering and Construction now examines each project phase for public involvement potential. The project team meets to discuss the schedule and the decision sequences. With help from public involvement specialists, they then plan a program to fit both the schedule and the needs of potential participants. The public involvement plan, which must be approved by the management of all affected organizations (including public involvement management), specifies activities to occur during the course of the project and how they relate to the project development in terms of project goals; information expected from the activity; timing; and categories of public addressed (e.g., individuals, landowners, environmental groups, government agencies, and so on). This new approach to public involvement means that the traditional engineering, environmental, and cost considerations used to determine siting preferences have been joined by a critical fourth factor: the degree of public acceptability. At BPA, this factor means that the publics help us define the range of alternatives, identify and evaluate the consequences, and evaluate the preference. For the future, we are undertaking a pilot study to determine the potential for public involvement in determination of need.

Benefits of the New Approach

Many benefits to the agency have emerged from the new, integrated approach. In this paper, we have chosen to focus on five of those benefits:

1) The broad assumptions on which the project is based are more carefully defined.
2) Route and design refinement can be undertaken at an earlier stage, when the project is still flexible.
3) Local knowledge can be used to produce a more accurate impact assessment.
4) Objectives of planners can be met better and in a more timely manner.
5) Job satisfaction and the commitment to effective analysis are increased.

The discussion below is keyed to specific project experiences, in particular to an ongoing 161-kV transmission project which began before the new public involvement effort and which benefited directly from the changeover.

More Carefully Defined Assumptions

Related Agency Benefits are: keeping on schedule; avoiding later restudy; presenting a set of choices that reflects the full range of public and agency views; avoiding large-scale public controversy; and maintaining professional reputation.

To determine the most acceptable transmission facility location, we need to know which values are most important to the agency and to the publics affected. Cost and engineering effectiveness are always of concern to the agency. But the agency and the publics may differ on which are the most important natural and social resources to preserve. For instance, is preservation of farmland of greater value to communities than preservation of scenic views? Is there a community consensus on the importance of various resources?

Assumptions about such values are derived from past experience with other projects, from researched information about a geographic area, and from public input. When, at the beginning, experience and research dominate the picture, or when early public input is scanty, we may proceed on faulty assumptions, and be unpleasantly surprised at public reaction to published findings. However, when community values are actively solicited and alternatives developed which respond to those values, the siting process improves for all.

The importance of this step is underscored by the public involvement planning on the Fall River project, a 161-kV transmission line proposal in southeastern Idaho. The project, under BPA's traditional planning mode, began the environmental process with "scoping" meetings in the spring of 1983. The public saw maps showing a broad corridor. Their concerns centered on avoiding impacts; first on farmland in the western part of the study area and second on a popular recreation and wildlife area in the east.

During the next year, a land acquisition specialist and a location engineer contacted individual landowners to determine what difficulties they saw with the developing alternative routes on their land, and how those problems might be solved. Because so much of the land is farmed, the main criterion in route location--and therefore the focus of discussions--was to avoid crossing farmland as much as possible. Wherever choices existed, route options were located in non-cultivated areas. Because most routes did not cross the mapped wildlife/recreation areas, we assumed that those resources were sufficiently protected.

Then, more landowner contacts spurred the project team to question that assumption. They reviewed the public involvement plan, and realized that they needed to contact those with differing values, to test their reactions to our work. So, we contacted non-farming landowners and we renewed contacts with cooperating agencies--other government agencies with land to manage in the area and groups with special resource expertise. We discovered that the second set of values revealed at the scoping meetings--preservation of wildlife and undisturbed recreational areas--was not adequately reflected in the route options. The sensitive area defined by standard maps was only the center of the recreation and wildlife concerns of numerous residents and agencies. Their "psychological map" was defined far more broadly. Our developing routes crossed into this important area.

The choice to expand contacts and to pursue value-oriented questioning was made in time to develop and improve alternatives before the agency's views were firmly set and recorded in the draft environmental document. Although no route can perfectly respond to all interests, we were able to find compromises that reflected the highest priorities for each. Public involvement markedly improved the definition of the route network. It also enabled us to stay on schedule and avoid the additional studies which would undoubtedly have been required if our alternatives had not reflected both values. The potential for large-scale controversy was reduced, and, as a side benefit, we avoided compromising the professional reputation of our studies. In future projects, we shall pursue value-oriented questioning at an earlier stage of public involvement, and will review contacts to ensure that no one broad value is overrepresented.

Earlier Route and Design Refinement

Related Agency Benefits are: tieing down site-specific needs; keeping on schedule; and avoiding pockets of controversy.

As the Fall River study entered the winter of 1984, centerline surveys needed to begin soon to meet energy deadlines. Surveying all routes would have meant an extraordinary expense, so a preferred route and design was needed. To determine that preference, we needed to find out what the public thought about our choices. Since the draft EIS was not scheduled for several months, some way had to be found to test proposed routes and identify public problems with (or plaudits for) them before resources were committed to surveying.

In addressing this problem, the project team discovered two critical gaps in the public involvement plan. First, although problems had been discussed with individual landowners, we had not generally reported back to the publics since the scoping meetings. They had not seen maps of the adjusted alternative routes, so they did not know how their comments and opinions had been used. The project team, in turn, did not know whether the alternatives developed represented an acceptable range of choices.

Second, no provisions had been made for formal public comment until after the draft EIS was published. Imagine the effect of a sudden request to survey landowners' properties before they knew which alternative routes had been considered or how their opinions had affected the process.

The team recommended that the agency determine a preliminary preferred alternative in the fall of 1984 and present it to the public at a series of workshops to be held in February 1985 while the draft EIS was being put together. By doing so, the agency could begin work needed for the surveys in late fall and winter, but would still have time to make changes to the routes and to the EIS if the public workshops showed that the amount of support for our preference had been misjudged.

At those public workshops, the team discovered just how important their recommendations had been. Although most workshop participants supported the basic preferred alignment, changes were requested at all three meetings. At the first, the team was asked to relocate a 1.5-mile (2.4-km) portion of the line to pass east, rather than west, of a community; at the second, to reconsider double-circuiting about 20 miles of line rather than paralleling an existing line through farmland; at the third, to choose an entirely different and environmentally less preferred route in the northern third of the project.

These meetings indicated how much opposition there was to various parts of the proposal, and gave us enough time to study the proposed changes to see if we could make them part of our preferred alternative. The community reroute was shorter but slightly more expensive. However, an analysis of the potential costs of public resistance encouraged the team to evaluate and then to recommend the community's preferred route. Although some residents are still not happy with the selection, the numbers of displeased landowners who dominated the meeting were substantially reduced. The team believes that the potential for legal delay of the project is correspondingly reduced.

The strong support for double-circuit construction through dryland farming sent the project team back to the drawing boards. Since original estimates had indicated that it would cost about $1 million more than paralleling, engineers were urged to find creative ways to make the double-circuit option more economical. The costs of <u>not</u> proposing the option we also considered. These included potential Congressional involvement, additional meetings, staff time in comment response, and potential delay of the project. With this analysis and an effective cost-cutting design, the agency was able to recommend the double-circuit option. Recent meetings on the draft EIS have confirmed the strength of the farmers' feelings and their satisfaction with the response.

After additional studies, the agency decided not to recommend the third requested change. However, a special report was prepared and sent to all participants, explaining the analysis and decision. We also identified specific areas of landowner concern in that area and began to work with individuals to mitigate problems. By the time the EIS was released to the public, affected landowners--even those displeased with the findings--knew that they had not been ignored and that BPA would try to meet their needs within the limits of the route preference.

By seeking out public comment on a preference before the draft environmental document was published, a solid information base was established for each of the four evaluation factors--engineering, environmental, cost, and public acceptability. This enabled the project team to refine routes and designs with confidence while the project was still relatively flexible. We could stay on schedule and begin surveying early enough to meet energy deadlines, despite planning delays. Finally, it defused and diminished much public controversy, by responding positively to strongly felt public concerns and preferences and by working actively and early to mitigate consequences for those affected. In the future, the agency will again attempt to present an early preference and to provide for and respond to early public comment, so that we may refine and incorporate any changes at a stage where it is easier and more effective.

Local Knowledge and Impact Assessment

Related Agency Benefits are: increasing predictive capability of analysis; increasing responsiveness of siting to natural and social factors; and saving time and money in construction and operation.

The best facility location can be determined when the analysis and research capabilities of the planners are complemented by the detailed knowledge of local residents. But sometimes a project may not seem complex enough to require early public contacts. This was the case as BPA began siting a new substation near Missoula, Montana. However, since agency-Montanan relationships had been strained by earlier work in siting a 500-kV line in the area, we decided to talk to people early, in order to bring out concerns.

A "scoping" meeting was planned in the small town where the substation was to be located. Personal invitations to the meeting and a map of the potential alternative sites were sent out to all nearby landowners. A week before the meeting we were called by a landowner on whose property two of the four potential sites were located. He told us that our alternatives were not viable, and took us on a guided tour, showing where his tractors had been stuck in the mud for days as he tried to install a drainage system. He also showed us high water lines several feet up on utility poles in his field. Although maps showed these areas to be outside the 100-year floodplain, he told us that these fields flooded quite frequently.

At the public meeting that evening, his neighbors supported his statements and suggested a new site. We built their ideas and information into the analysis, and selected their site, avoiding potential major problems of construction and operation in a clearly unsuitable place. Although reduced load forecasts delayed the need for the substation, the project team believes that, when needed, it can be constructed in a viable and economical location, thanks to the timely receipt of specific local knowledge.

Meeting Planning Objectives

Related Agency Benefits are: staying on schedule, and saving time and money in project planning and environmental analysis.

After identifying the decision steps for a project, public involvement planning focuses on setting objectives. The team consciously decides what it wants at a certain point in the process and how to get it. Setting objectives helps them decide what BPA needs to know from the various publics at each phase of project planning and what it needs to tell the public in order to elicit that information.

BPA first used team planning of public involvement for an expansion of the converter stations at each end of the Northwest-Southwest Intertie, an 845-mile, 800-kV direct-current transmission line between the Columbia River in northernmost Oregon and Los Angeles, California. The project, proposed at a time of surplus hydro power in the Northwest, would increase Intertie capacity to carry the surplus by 1000 megawatts. A governing objective was to complete the studies as soon as possible so BPA could obtain revenues from surplus power sales. Without controversy, the project could be studied and documented in an environmental assessment; with substantial controversy, the lengthier process of the environmental impact statement could take 1-1/2 years to complete.

Controversy over actual construction effects seemed unlikely: in BPA's service area, very little construction work would be required other than at the converter station itself. However, agency staff were concerned that the project would run into substantial opposition if people believed that the increased power carried on the lines would affect their health or the health of their animals or crops. The public involvement team decided to contact individually every landowner, government official, and interest group leader who might have concerns. It would let them know about the plans early, would provide accurate information on the health effects issue, and would try to bring out any issues that might be raised. The team felt that early action would allow time to respond to those issues without delaying the overall project schedule.

This technique matched the objective very well. First, BPA interviewers discovered that landowners had few concerns about health effects. In general, when landowners discovered that BPA did not want additional right-of-way or access roads, they were not worried about the project. Landowners and government officials were pleased to be contacted personally and early and informed of BPA's plans.

Then, because the team felt that the major objections might come from environmental and energy-related interest groups, the leaders of about 20 such groups were invited to a special briefing. No one came. When contacted again, most stated that earlier informal contacts with BPA officials had allayed their concerns. The two sides had agreed on a satisfactory approach to dealing with environmental issues. BPA was assured that it could proceed with the shorter, simpler Environmental Assessment; the interest group leaders were assured that their concerns would be addressed. This early public involvement had achieved agency objectives and enhanced our ability to meet project deadlines.

No project finishes without its setbacks, however. While we learned how effective the setting of objectives for public participation can be, we also learned that the composition of the planning team is critical to predicting issues and setting those objectives. The public involvement team did not include a representative from BPA's Fish and Wildlife Division, which would have alerted us to the fact that certain fisheries agencies should be consulted in early contacts. No one on the team had predicted that some groups would be very concerned about the effect on fish of the reduced spill from the dams (since more water would be run through generators to provide the surplus power). When the issue was raised, the team underestimated its importance, and so it received little attention until the EA underwent public review. The studies required for response to this issue are now delaying the issuance of the final environmental clearance. (At the time of writing, the overall project schedule has not been delayed.)

Public involvement planning clearly helps achieve planning and project objectives--so long as the issues raised are matched by the team members' expertise and ability to estimate significance. The composition of the team is a critical element to developing and assessing objectives. Once these are set, public involvement at early stages is an equally critical item in meeting them.

Job Satisfaction and Professional Commitment

Related Agency Benefits are: a more cohesive, better informed, and more creative project team; one which is more committed to contact, and negotiate with the public, resolving issues, and reducing the number of problems which require upper management intervention.

This last benefit eludes measurement: the increase in confidence, dedication, and pleasure in a job well done when the team is able to meet the objectives of the agency and of the public through effective public involvement planning and interaction.

When the draft Fall River EIS was released for public review in June 1985, BPA held open houses so that the public could meet the staff one-on-one to discuss their reactions to the revised proposal, the EIS, and/or how the project might affect them personally. We knew that not everyone would be happy: not all the recommendations made at the meetings the previous February had been accepted, and the line was still going to affect many people. And the project team did get some comments from landowners who were upset or who felt that not enough had been done for them. But we also consistently received two kinds of praise: compliments for doing what people had asked, and positive comments from people who respected our commitment and efforts to meet their needs--even when they had not completely been met. The team could feel successful in their abilities to listen, negotiate, and solve problems without reaching the impasse that would force decisions upward, to be solved at management level. Success on one project also gives team members the energy and the commitment to renewed efforts in public involvement and meeting the agencies' and the publics' needs.

Conclusions

Public involvement benefits not only the public affected by a transmission facility, but the agency or utility sponsor as well. Impacts are more accurately assessed when the assessment is based on local knowledge and values, as well as on the research and analysis of environmental staff. The planning process itself improves with formal recognition in the public involvement plan of key interim decisions that require certain information, both from within and from the public. With early and careful consideration of who could be interested in or affected by a project, the agency expands the pool of ideas from which it can draw, and broadens the range of alternatives available for analysis. Incorporating public involvement into planning allows the utility to refine routes and designs earlier, while alternatives are still flexible. And finally, the agency improves its ability to meet the objectives of both its own planners and the public by defining those objectives early in the process and planning strategies for meeting them. With these benefits comes the added one of the staff's greater satisfaction and commitment.

Strategies for Success

How should the process work in order to maximize its success?

The most important principle/strategy is to make sure that the project planning team and the public involvement team are the same people. At BPA, the public involvement team is led by the project team environmental representative, with advice from public involvement specialists on types of activities appropriate to each phase and on technical details of how to achieve their objectives. These specialists ensure that the team has thoroughly analyzed needs and opportunities. On the other hand, the project planners have the best knowledge of local politics, resources, and community values and interests. They are the best ones to decide the public involvement strategy for their project.

The project team also carries out the public involvement activities. They make all the contacts; run all meetings, workshops, and open houses; and contribute substantially to all materials prepared for the public. Because they are the ones who talk to the public, public comments are not filtered through a third party not directly responsible for action or response. BPA believes that the people responsible for planning the project should hear firsthand what the publics have to say, that they are the ones who can most accurately portray the project, and that they can best respond to public comment.

To be successful, public involvement planning must be done at the earliest stages of the project. It must be keyed directly to each phase of the decision-making process and must show how each public activity contributes to that process at key milestones. Such planning forces the team to recognize its interim decisions, and to decide what information it needs from both internal and external sources in order to reach those decisions.

Planning must be tailored to the circumstances of the project, the political climate of the area, and the characteristics, habits, and sensitivities of the publics involved. No one formula can serve adequately to meet the needs of multiple projects.

The most satisfying projects have been those in which BPA allowed itself the flexibility to adjust its proposal based on contributions from the public. When project staff recognizes public involvement as a valuable two-way communication and exchange, not a one-way public information program, then decision-making proceeds more logically, changes are made after reasoned analysis (not in response to emotional political pressures), and satisfaction of all parties visibly increases.

Future Directions

Much of BPA's future effort will focus on learning from and improving on past experiences in siting projects. In particular, there is a need to improve the composition and functioning of the public involvement team; to pursue a thorough definition of community values early in planning; and to review plans periodically to assess their effectiveness.

BPA also plans to examine the potential for public involvement in decisions that have traditionally been almost entirely internal ones, such as identifying and evaluating appropriate solutions to transmission system problems. This first phase in siting traditionally has been the province of agency planners. Their expertise and assumptions, however, are frequently challenged by the public. People have consistently questioned whether or not we considered carefully enough such alternatives as conservation, local generation, or some other means of solving a forecasted system problem.

The agency is beginning a pilot project to involve the public in such a decision-making process. One utility recently has successfully involved several hundred citizens in a long-range planning effort (Gould, 1984). It is, however, not certain whether or how much public involvement really helps make these decisions. Will the agency be relinquishing it's responsibility to plan and operate a safe and reliable system? Might we unfairly raise the public's expectations about how much they can contribute? Will all the effort merely be wasted, because the issues will be too technical for meaningful public participation?

These same concerns were expressed by the industry when it first contemplated involving the public on siting issues. Sometimes, the concerns were justified. But far more often we have found unexpected benefits in involving the public in defining alternatives, identifying and evaluating consequences, and recommending a preference. Their potential contribution to the first planning step--defining the need--will extend the cycle of valuable two-way communication to the earliest stages of project planning. In this integrated process, new light can be shed on decision-making, new strengths developed in joint planning, and better projects built.

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AN EX POST FACTO ANALYSIS OF THE ECONOMIC AND SOCIAL IMPACTS OF RESERVOIR CONSTRUCTION

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Introduction

This paper details selected economic and social impacts of reservoir construction operation and maintenance ten years after the project was completed. The case example is Lake Shelbyville, a multi-purpose impoundment planned, built and operated by the U.S. Army Corp of Engineers. It is located in central Illinois, approximately four hours by car from both Chicago and St. Louis. Data on agricultural land use patterns, private sector expenditures, community infrastructure development, perceptions and attitudes toward the project as well as community organization were obtained prior to and during construction and at selected times since operation and maintenance of the reservoir began.

The major conclusions of the economic and sociological components of the study are reviewed by asking the question "what has been the impact of the reservoir?" Furthermore, have expectations raised by a federal water project been realized? Each portion of the report responds from the standpoint of the population, institution or organization that was impacted. The paper concludes with important recommendations for state agencies that may be asked to support federal water projects in the future.

A Short History of the Lake Shelbyville Reservoir

In the pre-impoundment setting, both Shelby and Moultrie counties were typical prairie areas devoted to agricultural production. The population was declining as farms increased in size due to mechanization. Young people lacking farming opportunities, either moved into the service sector or commuted to jobs in distant urban centers. The flat prairie was ideally suited to energy intensive agricultural production. Labor could easily be replaced by machines. Employment in the region reflected the emphasis on agricultural and related services.

The Kaskaskia River which was dammed to form Lake Shelbyville flowed from North to South through both counties. Although the river flooded on occasion, the losses were greater downstream than in these two counties. The Kaskaskia drained most of Shelby County in an adequate manner, with some flooding in the upper ends of the Moultrie County.

Table 1 provides a chronology of events leading to the operation stage of the Lake Shelbyville reservoir.

TABLE 1 THE PRE-OPERATION PERIOD OF THE SHELBYVILLE RESERVOIR PROJECT, 1958-1973

Lake Shelbyville	Other Related Projects	
1958		Construction of Lake Shelbyville approved by Congress
1962 (Oct.)		First real estate acquired at Shelbyville
	1962 (Oct.)	Navigation project downstream approved by Congress
1963 (Apr.)		First construction contract approved
1963 (May)		Ground broken for first construction at Shelbyville
	1964 (June)	Shelby County hospital adds new wing
	1966 (June)	Work begins on canal excavation
1966-67		Shelbyville construction runs into problems of old mine shafts below river and a layer of bad shale
	1967 (Apr.)	Carlyle Reservoir begins operation
1970 (Sept.)		Dedication Day for Lake Shelbyville
	1973 (May)	Kaskaskia Canal ready for barge traffic

The Army Corps of Engineers attempted to develop a comprehensive plan to control flooding in the entire Kaskaskia Basin. The Lake Shelbyville reservoir was one component, but also included was Carlyle Reservoir and the Kaskaskia Canal (both completed) and numerous levees (never built).

Interest groups who saw benefits from the reservoir include downstream industrial interests, downstream farmers, upstream business and commercial interests, recreationists, and upstream landowners. Some of the interest groups that were active in obtaining the Shelbyville reservoir are now opposed to the way it operates - particularly downstream farmers. Since operation began, the fluctuating lake level has reduced the number of recreational visits.

During normal weather, all users of Lake Shelbyville within the Kaskaskia Basin, can be satisfied - water for the recreationists, slow release of water for the barge canal, some space in the reservoir for flood control and downstream flood protection for farmers. But abnormal weather brings conflicts among users that were compounded by the Corps' underestimation of channel capacity and what to do with the runoff that would normally be absorbed by tributaries. The Lake Shelbyville reservoir is smaller relative to the real watershed it must handle. By over-designing such projects in the future, these tensions between social groups could be alleviated. As it now stands, water for recreation and the barge canal conflicts seriously with flood control/farm protection during the rainy periods. Construction of planned levees might have helped, but they are expensive and would do little to help the tile drainage due to a full river.

Changes in Agricultural Income

Findings from this section, as shown in Table 2, indicate that a decline in agricultural revenues did occur because of the removal of land from production upstream from the impoundment. The lands removed from production included those lands flooded for the reservoir itself and those adjacent to the reservoir that underwent a change in use.

While it was found that a loss in net agricultural income did occur, the magnitude of that loss is still uncertain. The uncertainty regarding the magnitude of the loss has two sources: the lack of knowledge of production costs on the land removed from agriculture, and the restriction of this study to effects upstream from the dam. These areas south of Shelbyville were frequently flooded before the dam was built and represented one of the justifications for building the reservoir. However, Corps engineers anticipate that downstream flooding will continue until a levee system is developed locally to help with the flood control (U.S. Army Corps of Engineers, 1975). These effects therefore should be evaluated carefully to increase the accuracy of total effects of the entire reservoir project.

Future reservoir development by all U.S. Federal agencies will be subjected to "Principles and Standards" with support by extensive and accurate evidence of agricultural benefits and costs. Indeed, the regulations specifically disallow casual estimates or consideration of less than the whole benefit-cost picture of a given set of objectives. In the area of agricultural income effects of future natural

TABLE 2 ESTIMATED DIRECT EFFECTS AND TOTAL EFFECTS FOR THE STUDY AREA (Units: dollars)

	Direct loss due to water impoundment (agri. sector)[1]			Total losses due to water impoundment (agri. sector)[2]		
Year	Moultrie Co.	Shelby Co.	Total	Moultrie Co.	Shelby Co.	Total
1969	608 667	369 931	978 598	1 932 222	818 884	2 751 106
1970	708 653	426 670	1 135 323	2 249 629	944 482	3 194 111
1971	643 386	391 837	1 035 223	2 042 438	867 375	2 909 813
1972	901 064	539 481	1 440 545	2 860 440	1 194 202	4 054 642
1973	1 332 410	788 472	2 120 882	4 229 754	1 745 372	5 975 126
1974	1 496 010	884 134	2 380 144	4 749 105	1 957 131	6 706 236
1975	1 276 160	767 857	2 044 017	4 051 188	1 699 738	5 750 926
1976	1 433 330	863 912	2 297 142	4 550 126	1 912 145	6 462 271

1 Direct losses associated with basic level management from Table 7-5 (Burdge and Oprayszek, op. cit, p. 110) were used here.

2 Total losses were calculated by considering the income multiplier effects for the two counties.

resource projects, it will be very important for state and regional decision-makers to protect the interest of the state or region, since "Principles and Standards" use a National Economic Development stance to examine the economic feasibility of projects. Since Illinois is heavily agricultural in economic makeup, care must be taken to ensure that the agricultural benefits of federal projects do, in fact, equal or exceed the costs. In the case of Lake Shelbyville that was not supported by research.

Changes in Tax Base for the Reservoir Counties

This part of the Lake Shelbyville study was divided between impacts on property tax and those on other revenue sources (lease income, sales tax, and fines). In general, it was found that the land area included in the property tax base declined due to the appropriation of land by the Federal Government. This decline in land area is for the most part offset by an increase in land valuation and tax rates. The effect of the land appropriation and attempts to offset it were not uniform between the two counties. While both Moultrie and Shelby counties saw a general increase in revenues from property taxes, some townships in Shelby County experienced losses and the magnitude of revenue increases in that county was smaller on an average than those in Moultrie County (Tables 3 and 4).

The revenue from lease income is peculiar to a reservoir and although initially high in the two counties, will decline over time. Moultrie County receives more of these funds than does Shelby County. Both counties experienced an increase in revenues from fines with Shelby County receiving the largest share. This increase in fines is a reflection of the lake development. Finally, there was some sales tax revenue increase from restaurant and gasoline sales, which probably reflect the impact of the reservoir. However, Moultrie County's share of sales tax increased faster than the average for Southern Illinois counties while Shelby County's increase in revenues from this tax lagged behind the average.

Because farmland values increased rapidly during the study period at both the regional and national levels the increased valuation in land in the two counties may reflect this trend rather than any lake related impact. By 1985, agricultural land values had declined to a pre-impoundment level, reflecting the continuing slide of U.S. Agriculture.

TABLE 3 CHANGE IN TAX REVENUE USING MULTIPLIERS, SHELBY COUNTY 1965-1975

	Tax Rate		Assessed Value		Total Revenue		Change in Revenue	% Change	% Change	% Change
	1965	1975	1965	1975	1965	1975	1965-75	Tax Rate	Ass. Val.	Revenue
Shelby County	.292	.6546	$114 156 284	$142 777 539	$ 333 336	$ 934 622	$ 601 286	+124.2	+25.1	+180.4
General	.057	.1200	114 156 284	142 777 539	65 069	171 333	+106 264	+110.5	+25.1	+163.3
Roads	.124	.1858	114 156 284	142 777 539	141 554	265 281	+123 627	+49.8	+25.1	+87.3
Shelbyville Township	.553	.8284	19 539 649	23 099 061	108 054	191 353	+82 299	+49.8	+18.2	+77.1
Roads	.336	.4170	19 539 649	23 099 061	65 653	96 323	+30 670	+24.1	+18.2	+46.7
Okaw Township	.812	.5288	4 332 315	5 411 625	35 178	31 052	-4 126	-34.8	+24.9	-11.7
Roads	.487	.1700	4 332 315	5 411 625	21 098	9 200	-11 898	-65.1	+24.9	-56.4
Windsor Township	.710	.8752	5 210 820	6 326 715	36 997	55 371	+18 374	+23.3	+21.4	+48.7
Roads	.473	.6743	5 210 820	6 326 715	24 647	42 661	+18 014	+42.6	+21.4	+73.1
Todd's Point Township	.812	.7147	3 618 906	4 427 964	29 386	31 647	+2 261	-12.0	+22.4	+7.7
Roads	.513	.3211	3 618 906	4 427 964	18 565	14 218	-4 347	-37.4	+22.4	-23.4
Tower Hill Township	1.056	1.0824	3 995 527	4 770 251	42 193	51 633	+9 440	+2.5	+19.4	+22.4
Roads	.629	.6467	3 995 527	4 770 251	25 132	30 849	+5 717	+2.8	+19.4	+22.7
Oconee Township	.874	.8681	3 454 150	4 062 180	30 189	35 264	+5 075	-0.7	+17.6	+16.8
Roads	.579	.5543	3 454 150	4 062 180	20 000	22 517	+2 517	-4.3	+17.6	+12.6
Moweaqua Township	.485	.5618	6 714 605	8 385 035	32 566	47 107	+14 541	+15.8	+24.9	+44.7
Roads	.252	.2792	6 714 605	8 385 035	16 921	23 411	+6 490	+10.8	+24.9	+38.4
Sigel Township	.454	.5928	2 789 460	3 321 440	12 664	19 689	+7 025	+30.6	+19.1	+55.5
Roads	.303	.3820	2 789 460	3 321 440	8 452	12 688	+4 236	+26.1	+19.1	+50.1

Source: Shelby County Clerk, Shelby County Treasurer, and McLaughlin, op. cit., p. 85.

TABLE 4 CHANGE IN TAX REVENUE USING MULTIPLIERS, MOULTRIE COUNTY 1965-1975

	Tax Rate		Assessed Value		Total Revenue		Change in Revenue	% Change	% Change	% Change
	1965	1975	1965	1975	1965	1975	1965-75	Tax Rate	Ass. Val.	Revenue
Moultrie County	.341	.5375	$ 74 899 815	$ 99 413 150	$ 255 408	$ 534 346	$+278 938	+57.6	+32.7	+109.2
General	.183	.1909	74 899 815	99 413 150	137 069	189 780	+52 711	+4.3	+32.7	+34.5
Roads	.114	.1547	74 899 815	99 413 150	85 386	153 792	+68 406	+35.7	+32.7	+34.5
Sullivan Township	.593	.6903	19 702 435	26 833 710	116 835	185 233	+68 398	+16.4	+36.2	+58.5
Roads	.424	.5377	19 702 435	26 833 710	83 538	144 285	+60 747	+26.8	+36.2	+72.7
East Nelson Township	.701	1.3201	4 863 155	6 265 585	34 091	82 712	+48 621	+88.3	+28.8	+142.6
Roads	.447	.9269	4 863 155	6 265 585	21 738	58 076	+36 378	+107.4	+28.8	+167.2
Marrowbone Township	.614	.8895	8 296 005	10 857 235	50 937	96 575	+45 638	+44.9	+30.9	+90.0
Roads	.402	.4428	8 296 005	10 857 235	33 350	48 076	+14 726	+10.1	+30.9	+44.2
Whitley Township	.595	.7977	6 218 819	7 892 455	37 002	62 958	+25 956	+34.1	+26.9	+70.1
Roads	.446	.6263	6 218 819	7 892 455	27 736	49 430	+21 694	+40.4	+26.9	+78.2
Lovington Township	.686	.9922	11 290 010	14 290 010	77 449	144 660	+67 211	+44.6	+29.1	+86.8
Roads	.422	.6113	11 290 010	14 290 010	47 644	89 126	+41 482	+44.9	+29.1	+87.1
Lowe Township	.646	.7419	10 146 710	13 551 195	65 548	100 536	+34 988	+14.8	+33.6	+53.4
Roads	.470	.4950	10 146 710	13 551 195	47 690	67 078	+19 388	+5.3	+33.6	+40.7
Dora Township	.478	.8995	7 239 390	9 963 125	34 604	89 618	+55 014	+88.2	+37.6	+159.0
Roads	.296	.6897	7 239 390	9 963 125	29 491	68 716	+39 225	+133.0	+37.6	+133.0
Jonathan Creek Township	.584	.8517	7 143 300	9 470 135	41 717	80 657	+38 940	+45.8	+37.6	+93.3
Roads	.442	.6930	7 143 300	9 470 135	31 573	65 628	+34 055	+56.8	+37.6	+107.9

Source: Moultrie County Clerk, Moultrie County Treasurer, and McLaughlin, op. cit., p. 86.

Changes in Employment and Income

We now turn to the impact of the Lake Shelbyville Reservoir on employment and personal income. Two types of models were employed. In the first of these models, classical economic base theory was used to look at basic impacts (income brought in from outside the local area) and induced impacts (multiplier effects from the re-spending of the income brought in) from the reservoir. The other model was a shift-share model which analyzes changes in employment or income between economic sectors within a study area.

According to the adjusted estimates, the patterns and the magnitudes of the lake impact on employment in both counties were very similar. Except for the first few years of the project's construction, both counties appeared to be similarly impacted by the lake in terms of employment.

In terms of personal income, the adjusted estimates of lake impact are greater in real values than the original estimates since 1970 in Moultrie County's analysis and since 1969 in Shelby County's analysis.

The adjusted estimates indicate that the lake had negative effects on Moultrie County's economy in 1968, 1969, 1971 and 1973 with the greatest negative impact equivalent to a loss of about 1 250 000 dollars in 1971. The loss constituted only 2.57 percent of the total income. Positive impact equivalent to more than 4.5 percent of income in the county occurred in 1970, 1974, and 1975.

Changes in Business and Government Expenditures

The shift-share model developed for use in the section on changes in employment and income was applied to business sales and government expenditures. In the business portion of the study the model was applied to three small communities (Windsor, Bethany, and Findlay) and two large communities (Sullivan and Shelbyville) in Moultrie and Shelby counties. The analysis showed that the reservoir had negligible impacts on the smaller communities and more observable impacts on the larger ones (Figure 1). The actual impact of sales on the larger communities was understated by the analysis because during the reservoir construction period both Sullivan and Shelbyville were suffering from a decline in their manufacturing sector.

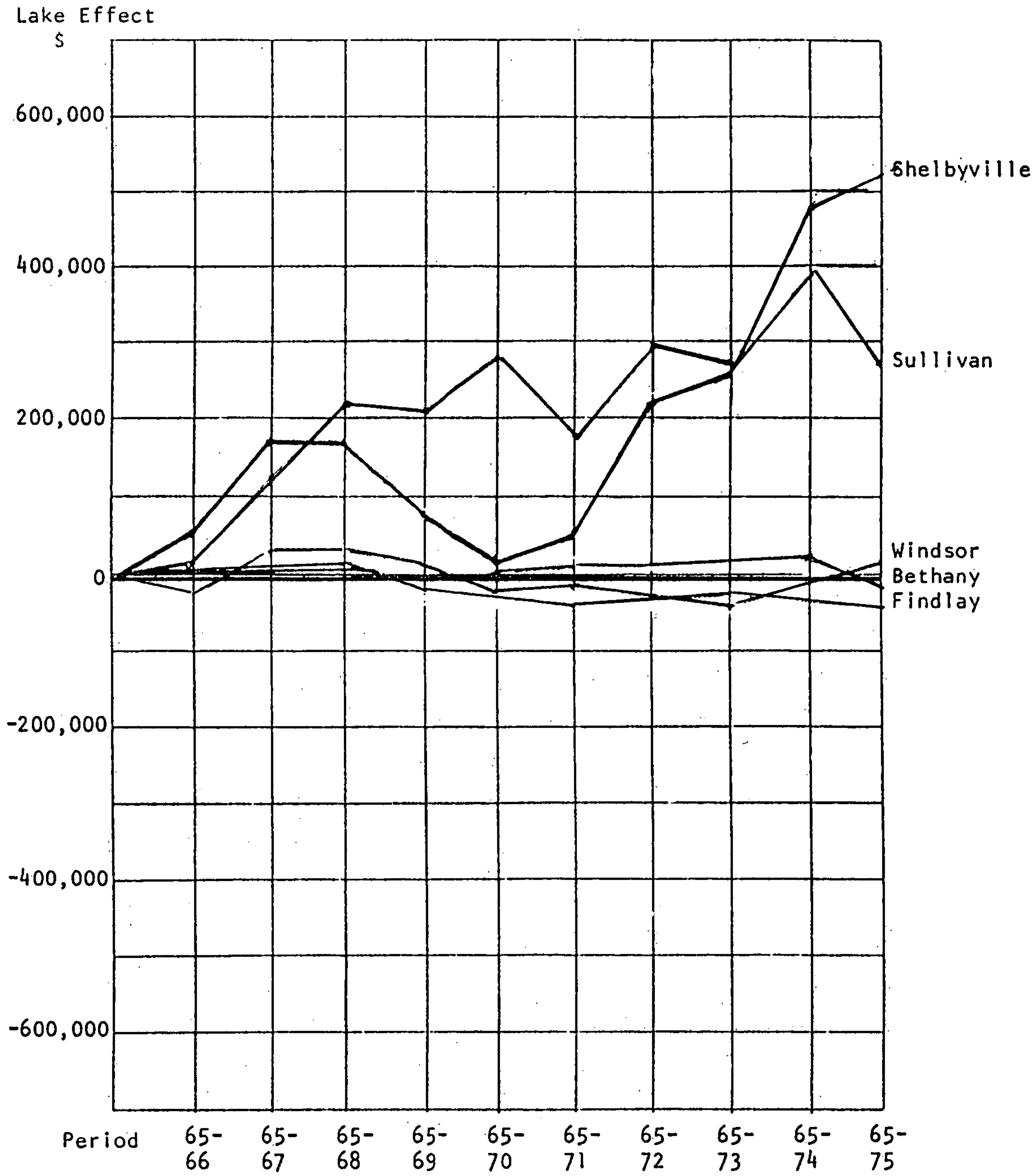

FIGURE 1 LAKE EFFECTS IN SALES CHANGES IN EATING AND DRINKING PLACES SECTOR IN FIVE TOWNS (Source: Suwanamalik, op. cit., p. 128.)

In the government expenditure section of the analysis, two conclusions stand out (Table 5). First, nearly three quarters of the expenditures (other than the construction costs) made by the U.S. Army Corps of Engineers during the construction of the project were retained locally. Secondly, local government expenditures tripled over the period of analysis. These increased expenditures occurred in those areas (roads, law enforcement, and planning and zoning) where lake impacts would be anticipated.

Changes in Business and Industrial Development

Over the 1965-1974 period, there were three major economic occurrences that developed simultaneously in the two-county area.

The recession which started in the late 1960s, and apparently ended in 1973 in Moultrie County, went on for at least two more years in Shelby County. Manufacturing was the sector most affected. Between the two counties, other things being equal, Shelby County seemed to be more affected by the recession and took a longer time to recover from it (Figure 2).

The drop in farm prices in the second half of the 1960s and the rise in prices that followed. The effects of this fluctuation were initially felt in the agriculture sector, but the overall effects on the entire economy must undoubtedly have been great, especially in areas such as those where agriculture was the leading source of income and employment. In this respect, Shelby County which was more heavily dependent on agriculture may be expected to be more affected by the price fluctuation than Moultrie County.

The Lake Shelbyville development had mixed effects on the economies. Among its negative effects, as reported in a previous section, were the loss of farmland which led to a decline in farm income and tax revenue; the dislocation of families in the project area that might result in a loss in population which ultimately means an economic loss to the area; and, perhaps, the temporary jobs generated by the lake might indirectly lead to losses of, or delay the development of, more permanent employment sources in the area. Among its positive effects on the economies were the economic impact of the construction, operation and maintenance of the lake, of the lake visitors' expenditures in the area, and of the limited commercial development brought about by the lake (Table 6).

TABLE 5 LAKE EFFECTS IN CHANGES IN SALES IN WINDSOR, SHELBY COUNTY

Sector	Lake Effects in Sales Changes over the Period[a]									
	65-66	65-67	65-68	65-69	65-70	65-71	65-72	65-73	65-74	65-75
General Merchandise	39 467	72 711	77 703	48 369	35 177	44 196	55 188	49 292	46 385	34 244
Food	-88 999	-138 966	-269 974	-73 244	-145 710	-109 377	-141 040	-102 797	-51 910	97 966
Drinking and Eating	-11 461	26 662	28 020	2 080	-16 714	-22 556	-25 040	-32 422	-16 845	4 733
Apparel	0	0	0	0	0	0	0	0	0	0
Furniture	-1 408	-1 752	-1 582	-2 163	403	4 919	33 451	35 114	35 593	27 433
Lumber, Bldg. Hardware	84 272	-387 709	-584 685	-517 729	-474 518	-429 556	-508 783	-595 732	-744 096	-1 111 968
Automotive, Gas Stations	-5 693	-98 022	-65 800	-107 861	89 845	-84 064	34 903	-44 212	-19 973	221 128
Misc. Retail, Wholesales	28 465	5 324	17 556	-55 740	-98 470	-61 381	-63 591	-77 459	-84 283	-109 887
Misc.	3 637	-36 013	-2 305	-1 391	28 978	11 602	13 423	53 573	44 655	37 039
Manufactures	-19 731	-3 774	6 302	-16 534	137 012	231 939	297 549	270 075	362 450	379 128
TOTAL	28 549	-561 539	794 765	-724 215	-443 998	-394 267	-303 941	-444 569	-427 024	-402 184

[a] In constant dollars, 1970 = 100.

Source: Suwanamalik, op. cit., p. 136.

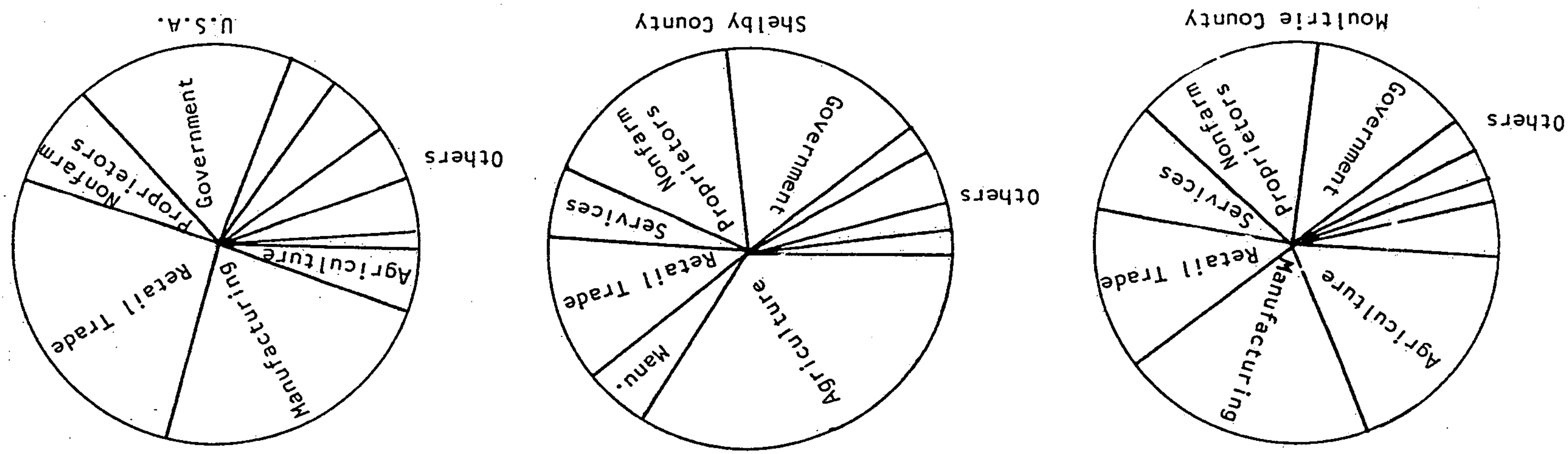

FIGURE 2 INDUSTRIAL MIX IN TERMS OF EMPLOYMENT, MOULTRIE AND SHELBY COUNTIES, 1973

TABLE 6 CHANGES IN EMPLOYMENT DISTRIBUTIONS, MOULTRIE AND SHELBY COUNTIES, 1965, 1969, and 1973

	Moultrie County			Shelby County			U.S.A.
Industry	1965	1969	1973	1965	1969	1973	1973
TOTAL EMPLOYMENT[a]	100% (4 398)	100% (5 469)	99% (5 101)	99% (6 755)	100% (7 048)	100% (7 071)	102% (87 820 142)
Agriculture	25%	23%	19%	38%	35%	34%	5%
Contract Construction	3%	4%	4%	2%	3%	2%	4%
Manufacturing	21%	15%	19%	13%	10%	5%	23%
Transportation & Pub. Utilities	1%	1%	2%	2%	2%	2%	6%
Wholesale Trade	3%	3%	3%	3%	2%	5%	5%
Retail Trade	11%	15%	15%	10%	11%	12%	14%
Finance, Insurance, Real Estate	2%	2%	2%	1%	2%	2%	5%
Services	8%	9%	9%	5%	5%	6%	13%
Nonfarm Proprietors	13%	16%	15%	12%	15%	16%	8%
Government	13%	12%	11%	14%	15%	16%	18%
Mining and Unclassified	-	-	-	-	-	-	1%

a May not add up to 100% because of rounding.

Source: Suwanamalik, 1978, 37.

The predictions of rapid and continuous growth upon which authorization of Lake Shelbyville was predicted - proved to be quite exaggerated. Unfortunately, the original benefit-cost analysis was done on a regional basis and did not provide detailed figures for the two county impacted area (U.S. Army Corps of Engineers, 1975).

Changes in Land Use and Zoning

The land acquired by the Corps for construction and operation of the reservoir changed the land from traditional agricultural uses to recreation. Most of the acquired land was previously used for pasture, timber or row cropping.

Based on a detailed study of Shelby County over the past 10 years, we conclude that the lake has induced a considerable number of land use changes both in the anticipation of its completion and during operation (Table 7). These changes have been in close physical proximity to the lake. Almost all these changes have been away from traditional agricultural use and toward business and residential use.

TABLE 7 DISTRIBUTION OF ZONING CHANGES BY YEAR

Year	No. of Changes	Year	No. of Changes
1965	1	1971	9
1966	3	1972	6
1967	7	1973	10
1968	3	1974	5
1969	2	1975	3
1970	4		

The Corps of Engineers recognized that both counties needed zoning and land use laws. They were instrumental in securing adoption. Although spot zoning changes did occur in Shelby County they were quite small. No doubt the presence of zoning laws deterred what might have been haphazard development in the reservoir area. As pointed out, both counties had zoning laws when construction began; however, no large developments were proposed that might test enforcement.

As shown in Table 7, most zoning changes occurred during construction and the initial operation phase of the reservoir. Almost all zoning changes that occurred for the two county area occurred adjacent to the lake (Figure 3).

Community Response to Reservoir Development

The major community problems that occurred were increased vehicle traffic that produced congestion and deterioration of roads designed for intermittent agricultural traffic. More traffic increased the amount of traffic citations issued (Table 8). In addition, demand for emergency and hospital facilities increased sharply. The presence of the lake did not increase to permanent population in the area, but probably slowed down the normal out-migration pattern common to rural areas (Table 9). No change was noted in the employment patterns of the two county area. In a separate study it was found the persons visiting the area for recreation were most dissatisfied with the conditions of local roads. An expansion of police, fire, health and sewage facilities and services was required to meet the needs of the recreation population (Table 10).

Adjustment of Shelby and Moultrie County Residents Relocated Due to Reservoir Construction

The research reported in Illinois and verified in both Kentucky and Ohio found that property owners, older individuals, smaller households, and people with strong ties to the area, are the most severely impacted by relocation. Data for the Shelby and Moultrie County areas come from interviews with a sample of persons (mainly household heads) who returned a questionnaire delivered to their house. Specific findings from the study are as follows.

Most people sought a new residence which was close in kind and location to the place which they were displaced. Most persons carried on similar occupational and family household positions after relocation, the important exception being that most of those forced out of farming either retired or changed from part-time to full-time industrial employment. Most displaced families improved their material comforts after relocation, but complained of unhappiness in the family, separation from friends and relatives and higher costs at their new locations (Table 11). The respondents were uniform in their dislike of the U.S. Army Corps of Engineers and felt that they were not treated properly during the acquisition and relocation phase.

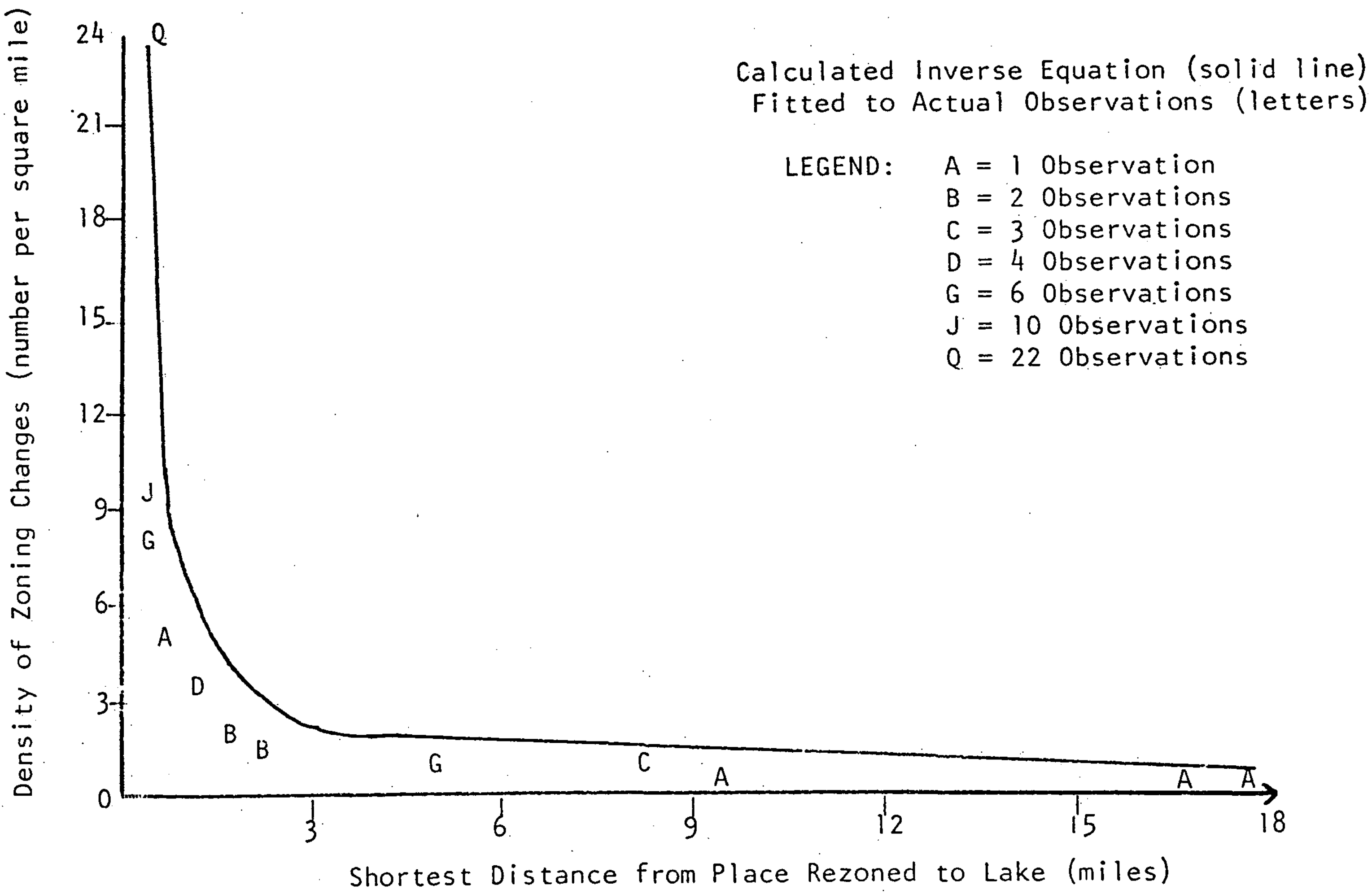

FIGURE 3 RELATIONSHIP BETWEEN DENSITY OF ZONING CHANGES (Numbers Per Square Mile) AND SHORTEST DISTANCE TO LAKE (Miles), SHELBY COUNTY, 1965-1975

TABLE 8 SHOWING COMPARISON OF PERCENTAGE CHANGE IN TRAFFIC COUNTS FOR THE LAKE SHELBYVILLE AREA AND THE CONTROL AREA PARIS - EDGAR COUNTY, 1966-1973

Year	Lake Shelbyville Area Percent Change	Paris-Edgar Co. Comparison Area Percent Change
1966-1967	+1.8	-2.9
1967-1969	+17.0	+15.8
1969-1971	+32.5	-3.4
1971-1973	-12.6	+9.7
1966-1973	+37.8	+19.2
	+37.8	Lake Shelbyville Area
	+19.2	Control Area
	+18.6	Traffic Increase Attributed to the Lake

TABLE 9 SELECTED POPULATION CHARACTERISTICS FOR SHELBY AND MOULTRIE COUNTIES

County	No. of Families 1970	Population Size 1960	1970	1980	1990*	2000*	Net Migrants 1970-1975
1 Shelby	6 151	23 404	22 589	21 291	20 854	21 830	100 (+4%)
2 Moultrie	3 558	13 635	13 263	12 746	13 619	14 749	100 (+0.7%)

* Estimated

TABLE 10 PERCENT OF RECREATIONISTS DISSATISFIED OR VERY DISSATISFIED WITH SELECTED LOCAL GOVERNMENT SERVICES (Lake Shelbyville Recreation Study, 1978)

Service	Percent Dissatisfied or Very Dissatisfied
Roads	17
Directional Signs	7
Police Security	8

TABLE 11 PERCEPTION OF CHANGES IN LIFE SITUATION AFTER DISPLACEMENT BY SHELBYVILLE RESERVOIR

Situation	Difference*	Situation	Difference*
Taxes	-18	Quality of schools	1
Cost of home	-13	Radio reception	1
Amount of land	-9	T.V. reception	1
Happiness in household	-9	Access to newspapers	2
Time of leisure	-8	Quality of roads	4
Indebtedness	-7	Distance to work	5
Distance to family	-4	Distance to shop	6
Economic security	-4	Distance to medical	
Job satisfaction		facilities	6
Distance to friends	0	Size of home	8

* Refers to the absolute difference between the number of households reporting improvement in situation and the number reporting a worsening in situation.

Social Effects of Land Acquisition

Information presented in this section comes from detailed ethnographic studies of individuals and families that had been impacted by land acquisition and relocation. Many of the families were centered in Okaw Township, just north of the town of Shelbyville. Field data were collected in 1982.

Land acquisition disrupts social networks upon which families, relocated or not, are dependent for financial and social resources. The resiliency of large groupings of interlocked families was lessened when constituent units lost land or were forced to relocate.

A farm family business is not the product of a single generation, or single family. It is intimately tied to the intergenerational land transfer process among many interconnected families. Thus, the time perspective in examining changes wrought by land acquisition and relocation must be extended if the full range of impacts is to be represented. Area-wide changes in land availability and land prices made the already tough task of establishing a land base and family farm even harder for some, as indicated in the case studies of several families. Acquisition of marginal farms served to decrease the economic and cultural diversity of the townships studied, concentrating farmland in even fewer hands.

The U.S. Army Corps of Engineers was felt to have misrepresented the lake project as an economic stimulus to the region. Expected revenues had not been realized and flood control management was perceived as poor.

Recreational Visitation Patterns at Lake Shelbyville

Lake Shelbyville is the most important water-based recreational facility in the east central Illinois region. However, when one moves outside the 100 mile circle of the reservoir, other recreation facilities can be found that are comparable to Lake Shelbyville. It seems unlikely that Lake Shelbyville will continue to expand its drawing power much beyond its present limits, especially when an increase in transportation costs from farther regions is taken into account. Even so, regional demand for the recreation opportunities provided by Lake Shelbyville will probably remain stable, if not increase, within east central Illinois.

Competing facilities are being developed near Lake Shelbyville that may draw off some of its visitation, just as Shelbyville drew off visitation from other areas when it opened. Although only half the size of Lake Shelbyville and with less developed camping facilities, Clinton reservoir in DeWitt County is likely to siphon off some visitation, for two reasons. First, since it is a new reservoir, the fishing at Clinton is likely to be better than that at Shelbyville. Second, the Clinton reservoir is located about as far north of the city of Decatur as Lake Shelbyville is south. Decatur was the residence for the single largest group of 1978 Lake Shelbyville visitors (13.9 percent).

In all probability, Lake Shelbyville will continue to receive the heavy amount of use it currently does (Table 12). Declines in visitation stemming from competing facilities in the region and reduced visits from more distant points are likely to be offset by increased local demand for water-based recreation, caused in part by many east central Illinoisans seeking recreational opportunities closer to home (Table 13).

Local Economic Impact of Recreation Expenditures

Overall, the impact of recreation expenditures on personal income in Shelby and Moultrie counties has been slight when compared with other sources such as agriculture. It has been much less than the optimistic expectations of early civic boosters of the project. It has also been far below the forecasts of Army Corps of

TABLE 12 ANNUAL LAKE SHELBYVILLE VISITATION[a]

Year	Number of Visitor-Days	Year	Number of Visitor-Days
1970	1 192 726	1975	3 076 594
1971	2 627 697	1976	2 997 238
1972[b]	3 900 834	1977	3 577 883
1973	2 803 458	1978	2 937 241
1974	2 827 970	1979	2 640 415

a Source: U.S. Army Corps of Engineers, 1975.
b First full year of recreation operation.

TABLE 13 DISTANCE TRAVELLED AS A PERCENTAGE OF LAKE SHELBYVILLE VISITORS IN 1973, 1978 AND 1979

	Percent of Visitors		
Distance Travelled	1973[a]	1978[b]	1979[a]
1-25 miles	45%	25%	28%
26-50 miles	26%	26%	32%
51-100 miles	14%	23%	13%
100+ miles	15%	26%	27%

a Source: U.S. Army Corps of Engineers, 1975.
b Source: Burdge et al., 1979.

Engineers' planners. One reason for this shortfall is that reservoir visitation has never reached the levels anticipated, but additional factors can be cited. The figure of $15 900 000 used in early planning documents was an estimate of gross sales to recreationists, rather than a projection of net earnings from these sales. Also included in the gross total were sales to local residents using the reservoir. However, in all probability expenditures by these visitors represent a recirculation of money already in the local economy. Both practices inflated the magnitude of the projected impact over and above the contributions to personal income that can be uniquely attributed to Lake Shelbyville.

Undoubtedly, the impact of visitor expenditures in communities immediately adjacent to the reservoir represented a somewhat higher proportion of total personal income than in Shelby and Moultrie counties as a whole (Table 14).

TABLE 14 AMOUNT AND LOCATION OF TRIP-SPECIFIC[a] EXPENDITURES AT LAKE SHELBYVILLE (May-October, 1978)

	Nonresidents		Residents	
Average Expenditure per Trip:				
At Home	$19.62	(29.1%)	-	
En Route	8.70	(12.9%)	-	
In Vicinity	38.99	(57.9%)	$31.95	(100%)
Total per group	$67.31	(100%)	$31.95	(100%)
Average Expenditure per Visitor-Day	$10.94		$11.31	

a Includes gas and oil for cars and recreational vehicles, groceries and beverages, entrance fees, restaurant meals, and motels.

However, the manner in which economic data are typically aggregated did not allow for an examination of impacts at anything less than the county level. Nevertheless, even if the "micro-impact" in areas immediately surrounding the reservoir was extremely heavy (and the low level of retail and service development in the area makes this seem unlikely), it is a weak primary justification for a development of the magnitude of Lake Shelbyville. Future claims arguing that recreation expenditures occasioned by reservoir construction will provide a substantial stimulus to local economies should be weighed against other potential costs and benefits of the project, as well as against the contrary findings of this particular study (Table 15).

Weekend Residents: Taking Without Caring

The last finding section deals with relationships between the local residents and the recreationists that came to use reservoir facilities. Most of the interviewers were concentrated in the south end of the lake, which has the most access points. The varied impacts reported here are neglected in most social projections of user-impact on recreation areas. Many of the impacts are attitudinal and primarily negative toward outsiders in general. Not to be neglected, however, are the quantifiable economic impacts such as equipment damaged because of litter, costs associated with cleaning up the roadsides, damaged fences and crops, and increased risks due to road hazards. Even the

TABLE 15 TOTAL BASIC AND INDUCED IMPACT OF VISITOR EXPENDITURES IN SHELBY AND MOULTRIE COUNTIES, May-October, 1978

Type of Expenditure	Basic Impact: Direct	Basic Impact: Direct and Indirect	Induced Impact	Total Income Impact	Personal Income
Nonresident[a] Trip-Specific Expenditures	$ 1 367 000	$ 1 529 000	$ 627 000	$ 2 156 000	0.84%
Nonresident[b] Seasonal Expenditures	$ 172 000	$ 209 000	$ 85 000	$ 294 000	0.11%
Combined	$ 1 539 000	$ 1 738 000	$ 712 000	$ 2 450 000	0.95%

a Includes purchases of gas and oil for cars and recreation vehicles, groceries and beverages, restaurant meals, motels, and entrance fees.

b Includes purchases of sporting licenses, repairs to cars and boats, and purchase and repair of miscellaneous other equipment.

inability to attempt road repairs without risking contempt of the recreation user population is an impact.

As an example, Okaw Township residents perceive the influx of recreationists as severely taxing limited emergency and law enforcement services, as well as degrading the lake access roads. Until very recently, the voters of this township steadfastly refused to increase their own tax burden to maintain the roads. Current costs of providing the minimal level of maintenance to one mile of road are about $5 500. With 35 miles of road to maintain, the total is well over $190 000. However, only $60 000 in 1981 had been budgeted for road repair. While the state and federal governments have spent many thousands of dollars on select roads within the township, theirs was a one-time contribution.

The county and Corps administrators seem to feel that the local populace's reticence to increase their own tax rate for road maintenance is an evasion of legitimate fiscal responsibility. Locals do want good roads for everyone; however, they do not feel it fair that the township must continue to pay, year after year, for what they do not tear up. An insignificant amount of monies is received from recreationists to help alleviate the user costs. Thus, the residents view the township's attempt to put the financial burden back onto the county, state and federal government as a just way of regaining control usurped when their communities were developed by outside powers. These attempts help locals maintain self-respect in spite of having little choice but to host weekend residents who take without caring.

Concluding Observations

What really happened at Lake Shelbyville? The project was hatched in the post World War II era where large federal projects were seen as the solution to a variety of problems. Everybody was seen to benefit from flood control: improved water quality, a steady supply of downstream water, recreation benefits for an area that had none, and, of course, help for a local economy that increasingly depended upon a declining agricultural industry.

The recreation opportunities materialized as predicted, although not as many people came as was hoped. Those who did come were mostly locals and what they spent cannot be counted as an economic contribution. Except for the marinas and grocery stores, the recreation related business has never boomed. Probably 75 percent of the benefits to the area come from reservoir related recreation. If the Corps were in the business of providing recreation, then they did a good job.

The miscalculation on the downstream carrying capacity of the Kaskaskia has antagonized an early support group, namely downstream farmers. Anticipating some of the side effects of the downstream flooding problems would have provided a better picture of project costs.

The loss of agricultural income has never been replaced because the reservoir sponsored no new development to take its place. While some compensation is being made to the tax base for land taken by the project, those payments will diminish with each passing year.

The problem of roads and road maintenance likely will never be solved. Township governments do not have the taxing capacity to maintain roads for recreational travel. That problem could have been dealt with in pre-project arrangements.

Population increases have never materialized and the lack of lake related development has not generated new employment opportunities. The lake has probably slowed down an out-migration that would be normal for an agricultural area that was experiencing farm consolidation due to mechanization. Farmers displaced through acquisition probably forced a temporary increase in the price of farmland as they sought new holdings. However, the continued depression in agriculture has led to even lower land prices.

Local communities did increase the size of law enforcement agencies as a result of the lake. In addition, the size of search and rescue operations increased and the capacity of the local hospital was expanded.

Based on the analysis presented in this paper we can say that the Lake Shelbyville project never met its expectations. However, the most serious impact that the lake brought was the arrival of a new, very big and powerful neighbor to Shelby and Moultrie counties. The new neighbor is a government agency represented by the U.S. Army Corps of Engineers. The neighbor was not like the others, because it played by rules established in Congress, the district headquarters in St. Louis and the Illinois legislature. The norms by which the Corps operated were those of a large bureaucracy and not those of a small rural community like Shelbyville or Sullivan. People still talk about mistreatment during land acquisition. They blame the Corps for the bad roads and the weekend traffic. Most of all they feel the Corps is not sensitive to their needs because the Corps has no reason to be responsive to local interests. The lake manager at Shelbyville at the time of the study was seen as a good person, but he was also seen as someone charged with carrying out Corps' directives.

Probably the best summary of local attitudes towards the reservoir comes from one farmer:

> To me, all these lake projects that are put in, no matter where . . . those sponsors of the project are not explaining the full facts to these people that have to live in the area after it goes in--the people who have to live with it year after year. If these sponsors would explain the facts to the residents and all the trouble with taxes, roads, outsiders and so forth, fewer lakes would be approved. At least we would know what to expect and carve out a more equitable arrangement.

Suggestions for the Decision Agency

1. Development projects often take decades for planning and implementation. As such, the persons who make the initial decision may no longer be involved. Regulations governing the activity may no longer apply. Furthermore, records can be lost. In the case of Lake Shelbyville, this was a problem for the State of Illinois. Some errors were made as in the underestimate of the size of the channel below the dam and failure to take into account the capacity of upstream tributaries during high water. The Corps did not respond to repeated requests for detailed information to verify and analyze their cost-benefit ratio.
2. The decision agency (in this case, the State of Illinois) should develop a computerized record system for storing and receiving relevant project data. The development agency (in this case, the Corps) should not be relied upon to maintain project records.
3. The decision agency must not assume that the development agency has total expertise and the best interests of the local population at heart. The continued disruption of the local transportation system by visitor use of the reservoirs and the error by the Corps in the boundary surveys suggests that state and provincial governments must be more active in protecting local interests.
4. The history of the Lake Shelbyville project suggests that an appropriate relationship between state government and federal agencies could be an employer-employee relationship, with the state as the "employer". The state would give more attention to project demands on its locality; require data sharing as part of the price of participation; verification of a particular agencies' "references" by inquiring about competence and cooperation in recently completed projects in other states; "auditing" the agencies' technical competence on selected critical points (especially where an agency has a history of failure); rejection of funding when project execution is incompatible with state goals; inclusion of penalty, lawsuit, and damage clauses in federal-state contracts and agreements to provide the state with recourse for federal failure, ready recourse to lawsuits as the last resort; and finally, withdrawal of state approval by the Executive and Illinois Congressional Legislation.

5. Federal agencies differ in technical and administrative capabilities. Furthermore, considerable variation in quality exists between departments in federal agencies. Decision agencies at the state and local level should not be intimidated by the size of the federal bureaucracies, realizing that each is made up of small pieces - some good, others not so good.
6. Decision agencies should remember that the serious and long run negative impacts of a project will only hurt the state and its local populations. The development agency (in this case the Corps) is neither responsible nor accountable to the local community.
7. The decision agency should adopt a more supervisory and skeptical (aloof) attitude toward execution of federal projects. Precedent is available from the Constitution of the State of Illinois, "The public policy of the state and the duty of each person is to provide and maintain a healthful environment for the benefit of this and future generations" (Article XI, Section 1).
8. The decision agency should promote a local citizen's advisory board which would provide feedback to the public and state government regarding the development agencies' activities. That advisory board should remain in place after the project has been developed. In the case of Lake Shelbyville, the Kaskaskia Valley Association disbanded after the project was built. Had that organization remained, people in the two county area would have retained a legitimate platform from which to respond to the Corps' activities.
9. Lake Shelbyville should not be abandoned as a study area. Baseline data have been obtained and much is known about the area. The urgency of water resource development has receded but other resource development planning has taken its place, i.e., energy (coal). The study remains timely although the impact setting has shifted.
10. The Lake Shelbyville study points out that an institution-building job is needed at the state level to exercise oversight on federal (and private) development planning proposals. State institutional capability for responding to these is needed as part of a large effort towards comprehensive development project review.

Prologue

Despite considerable evidence to the contrary, attempts to salvage an economic component from the Lake Shelbyville Reservoir continue. The State of Illinois Department of Conservation has appropriated funds for the construction of a resort style hotel-motel complex within the present State Park. The hope being that such a resort will attract convention trade and enhance tourism development in the region. The decision to proceed was made despite a slow decline in the region's population, the decline in recreation-related receipts since 1980, and the continued deterioration in the fishery of the lake. Local residents complain that the issue of who pays for the maintenance of the access roads has never been solved to their satisfaction.

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PART III

PROJECT IMPLEMENTATION

AND

MANAGEMENT PROCEDURES

ENVIRONMENTAL FOLLOW-UP TO FEDERAL PROJECTS: A NATIONAL REVIEW*

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Introduction

In 1983, the Environmental Impact Systems Division of Environment Canada began a study of environmental follow-up to federal projects. This paper is based on the results of that study. It draws on interviews with EIA practitioners in Environment Canada and other federal departments, including those commonly responsible for undertaking projects and on case studies of exemplary practice. This approach permits both overall perspectives on the status of environmental follow-up within the Selline system and the identification of factors that encourage or impede different types of follow-up. These are discussed in the main body of this paper, together with the considerations that need to be taken into account when planning follow-up activities.

Background to the Study

The Federal Process

The federal Environmental Assessment and Review Process (EARP) is applied to proposed projects and activities in which the federal government has a financial, real-estate or mandate interest.[1] It involves a phased approach to impact assessment. Projects are initially screened for environmental impacts and mitigations are proposed where needed. The effort put into screening varies, depending on the significance of the predicted impacts and the capability for mitigation. When it is judged that significant environmental issues have not been resolved, there is provision to refer a project for formal public review. Following assessment and review,[2] the federal agency that is responsible for the proposed

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project is expected to ensure that recommendations from this stage are effectively addressed during project construction and operation. Thus, a requirement for follow-up is indicated.

Types of Follow-up

In this paper, four generic types of follow-up activities to environmental assessment are recognized:

1) Surveillance to ensure that regulatory requirements and performance standards are complied with and that the recommendations from the assessment are incorporated into project design and are implemented in construction, operation and abandonment.
2) Monitoring of the actual environmental effects of the project.
3) Evaluation of the accuracy of the assessment and the effectiveness of the recommendations and mitigative measures.
4) Auditing of the performance of organizations in satisfying their environmental goals, objectives and responsibilities.

The federal process calls for certain of these follow-up activities. The agencies responsible for projects are required to undertake: 1) surveillance of project implementation; and sometimes, 2) monitoring, if it is required in the assessment. Auditing requirements are limited to reporting of the number and nature of initial assessment decisions that are made.[3] Follow-up beyond this falls outside the formal requirements of EARP; although it may be undertaken by concerned agencies.

The Role of Follow-up in Federal Activities

Two characteristics of the federal process affect follow-up and the manner in which it can be pursued by environmental agencies:[4]

- EARP is based on the principle of self-assessment. The agency responsible for a proposed project is responsible for assessing its environmental impacts and determining the correct response to environmental concerns.
- The process was established by an Order-in-Council of the federal Cabinet. It is not legislated. While federal agencies are directed to implement EARP, there is no system of penalties for non-compliance.

The role of environmental agencies, such as Environment Canada, is to provide data and advice to the agency undertaking assessment, and often to review the results of assessment work. Environment Canada is also charged in its departmental mandate with ensuring that human activities in Canada are undertaken in an environmentally acceptable manner.[5]

To influence the decisions and actions of agencies responsible for projects, Environment Canada must rely largely on the provision of effective advice, and advocacy of sound environmental management of projects. To that end, it must perform effective follow-up. Given the characteristics of EARP, there is little that Environment Canada, or any other environmental agency, can do to ensure that the responsible agency will conduct an assessment in any particular way. Neither does Environment Canada have any formal means to ensure that the recommendations from the assessment will be addressed, beyond enforcing the Department's environmental protection and conservation legislation during project implementation. A potential limitation here is that Environment Canada's regulations do not always cover all of the environmental concerns and recommendations for a given project.

In general, follow-up by environmental agencies is one of the major means of encouraging and improving the implementation of EIA and the quality of environmental work done on federal projects. Despite its importance, however, follow-up must be carried out through persuasive advocacy, often in the absence of strict enforcement capabilities.

The Status of Environmental Follow-up to Federal Projects

Overview

At present, there is little evidence of **consistent programs or procedures, scientific or administrative, for a comprehensive approach to follow-up. In addition, virtually all of those interviewed for this study stated that follow-up is not done to the degree that it should be within the federal system.**

Follow-up by those responsible for projects is often limited to checking contract and permit specifications. Follow-up by environmental agencies is commonly limited to various forms of surveillance and is undertaken on an "if possible" basis - as resources allow. Occasional effects monitoring programs and sporadic technical evaluations are the exception, and, in general, agencies do not audit their performance within the Environmental Assessment and Review Process in a way that contributes substantially to quality control.

Surveillance

Particularly for projects judged to have a minimal potential for environmental impacts, checking by environmental agencies that their advice has been addressed is predominantly reactive. Situations are dealt with after they have been brought to the attention of the environmental agency. Less commonly is follow-up by environmental agencies in place to ensure that problems are caught early or that they do not occur at all.

One cannot conclude from this situation that federal projects are implemented with disregard for the environment. It is the agencies responsible for the projects, not the environmental agencies, that are responsible for the quality of the environmental work. The point is that the environmental agencies often simply do not know: 1) the quality of the environmental work on a particular project; 2) whether or not their advice was taken; or, 3) if the advice was effective.

Projects with potentially significant environmental impacts are usually subject to more surveillance by those concerned, ranging from site visits by individual staff to coordinated follow-up by post-assessment task forces and committees. An important question here is, considering resource limitations, how much follow-up is required for a particular project? Small projects have little potential for environmental impact, and do not warrant much expenditure of effort unless these are potential cumulative impacts. The need to prioritize and plan follow-up activities is obvious.

Monitoring

Regulatory compliance monitoring is undertaken by environmental agencies with as much diligence as resources allow. Ongoing environmental monitoring is also done, when possible, in areas of interest, such as the impact zones around selected industrial developments. Project specific environmental effects monitoring programs are becoming more common for high-profile projects, often being funded jointly by the government agencies and private organizations involved.

Evaluation

There is little evidence of organized attempts to evaluate the accuracy of assessments. Evaluation of the effectiveness of recommendations is, when performed, generally limited to determining whether or not a certain impact was prevented by the proposed mitigation. More broadly based evaluations, addressing, for example, cost effectiveness or advancement of standard practice, are not common and usually occur as special projects. One major factor contributing to this situation, in addition to limited resources, is the absence of a focal point for collecting and synthesizing information on project implementation. As a result, data for evaluation are scarce and scattered.

Auditing

The agency responsible for administering EARP is the Federal Environmental Assessment Review Office (FEARO). The Office now requires all agencies to report annually on the number and nature of initial assessment decisions taken.[7] This audit requirement, although certainly useful, does not constitute an effective quality assurance program. The question "How many?" cannot be related to "How good?".

Meaningful auditing of federal government implementation of EARP has been limited in the past to contracted studies by consultants. Such studies contributed to the recent revision of the Order-in-Council for EARP.[8] One could argue that improved auditing would contribute substantially to improved performance under the process by federal departments.

Despite the overall poor status of follow-up, exemplary cases of surveillance, monitoring, evaluation and auditing were identified. Instances were also found where office procedures or policy guidance contributed to the overall success of follow-up activities.

The best guidance identified for performing follow-up is in the Parks Canada (1981) manual on the application of EARP.[9] This includes a discussion on "Project Monitoring", covering the technical aspects of follow-up (implementation of recommendations, effects monitoring and evalution of mitigations), but does not address auditing.

The implementation of recommendations is greatly facilitated if these are presented to project managers and contractors in an easily useable format. Notable success in this regard has been achieved through using environmental protection plans, which vary in form and detail according to the project at hand. While generating such plans is usually a project specific initiative, environmental protection plans were made a part of standard operating practice in the Western Region of Public Works Canda (discussed in the next section).

Factors Conducive to Follow-up

From the case studies, factors were identified tht contributed to or hindered follow-up (see McCallum, 1984).[6,10]

Effective follow-up depends as much on the circumstances surrounding a project and the group of interested agencies as on the actual techniques used. The following were found to contribute to the ease and effectiveness of follow-up:

- positive attitudes towards environmental impact assessment by the agencies responsible for projects;
- a well defined proposed project;
- a high profile environmental issue due to some clear agency or public concern about the proposed project;
- significant financial implications for the agency responsible for the project should problems occur;
- established communications between all main actors prior to review of the project in question and clear mutual expectations;
- credible environmental agencies with a history of useful input and diligent surveillance;
- good cooperation between advisory and regulatory agencies, so that environmental stipulations can be written into permits and licenses;
- well done environmental assessment work, with follow-up requirements specified and prepared for;
- a well understood set of responsibilities and a system to guarantee accountability (an environmental management framework);
- available or obtainable resources for doing the follow-up;
- reasonable project time lines so as to allow:
    1. issues to be identified and resolved in an atmosphere of unforced negotiation and cooperation; and
    2. resources to be identified and devoted to environmental work in an incremental manner, from existing budgets, without putting a large short-term drain on advisory and review agency resources;
- continuity of staff between assessment and follow-up stages; and
- correct information gathered and made available.

Specific means to induce these circumstances through the planning and management of environmental assessment activities are presented in the draft overall report (McCallum, 1984).[11]

Factors Limiting Follow-up

Resource Limitations

Environmental agencies encounter a continuous stream of project proposals requiring review. Due to inconsistent quality, there is sometimes little difference in the effort required between reviewing an assessment and actually doing one. As a result, the resources of review agencies become stressed at the assessment stage to the detriment of doing follow-up. Also, budgeting by the agencies responsible for projects is often not adequate for environmental work beyond the initial assessment. Opportunities for the sharing of follow-up costs with the responsible agencies are limited.

Lack of Clearly Understood Responsibilities

There is an inconsistent understanding by federal government staff of the particulars of EARP, and of EIA in general. Where the responsibilities at the assessment stage are not clearly known, understanding of follow-up responsibilities will suffer accordingly. In addition, there is insufficient guidance on follow-up (policy, procedures, techniques) provided to the staff responsible for performing it.

Mandate Limitations and Management Decisions

Program priorities in certain areas of an agency's mandate can limit potential follow-up activities in others. Also, the tendency of resource managers and regulators to restrict their interests to their own specific responsibilities and priorities can be a limitation since all of the environmental concerns might not be addressed.

Inadequate Environmental Assessments

Proposed projects are not always adequately described. The description given in the assessment may be incorrect or incomplete, and designs can be changed following assessment and during construction. The resulting problems for relating impacts to a specific cause are obvious. The predictions made during assessments are sometimes too vague or made in ways that render them untestable. In such cases, not enough thought is given to the need to follow up or to the implications for experimental design.

Inadequate or Inappropriate Follow-up Techniques

Inadequacies in baseline data are not always recognized and acted on during the assessment phase. This limits the effectiveness of monitoring and evaluation efforts. Follow-up data itself may not be useful, if it does not relate to any of the predictions or is in a form that is not conducive to the testing of hypotheses. Finally, project data that are necessary for follow-up to be accomplished (project description, predictions from the assessment, etc.) are not always readily available to those attempting the follow-up.

Planning for Follow-up

While follow-up is accomplished in many areas of Environment Canada's mandate, there is neither an explicit method nor detailed guidance for planning follow-up activities to EIA. The judgement as to what follow-up is to be done, and how, is left to the responsible managers (who are charged with doing follow-up "as required"). Timely and thoughtful planning by these individuals can promote some of the factors conducive to follow-up and can address some of the limitations.

During the study, preliminary information relevant to the planning of follow-up was analyzed for discussion purposes (McCallum, 1985).[12] That analysis continues and will be made available for planning Environment Canada's follow-up activities. The main findings to date are presented in this section. These are discussed in the context of their application to Environment Canada but they are probably relevant to anyone planning follow-up or managing an EIA program.

Developing a Strategy for Project Follow-up

Planning for follow-up, on the part of proponents, initiators, advisors and reviewers, should commence early in the assessment process. Early planning enhances the ability to generate the circumstances, noted earlier, that are conducive to the ease and success of follow-up, and can overcome some of the limitations. The level of effort to be expended in planning for follow-up should be dependent on the importance of the case.

A follow-up strategy must address the questions of what follow-up is to be done, how it is to be done and who is going to do it. The strategy must also ensure that concerns regarding information (e.g., baseline data, information availability), and accountability are addressed early in the planning stage. The general question "What follow-up should be done?" resolves into two specific questions: "What types of follow-up are needed?" and "How much effort should be devoted to each type?".

The type of follow-up undertaken should be based on a consideration of the benefits that can be generated by reviewing that particular project compared to the benefits generated by following up other projects, assessing new projects, or performing other program activities with the available resources. The type of follow-up required depends on the characteristics of the proposed project, the environment and, for an environmental agency, the proponent. Some of the potential benefits from different types of follow-up are outlined in Appendix 1.

The factors to consider in determining the level of effort to devote to follow-up include:

1. the legislative mandate and regulations of the agency;
2. the implications for the environment if follow-up is not done;
3. the ability of staff to accomplish the work in a cost-effective and high-quality manner; and
4. the potential advocacy and educational values of the case. Follow-up can be used to motivate other groups regarding issues. It can support advocacy, professional development of the staff, and overall advancement of the environmental sciences.

Once the type of follow-up and the level of effort to be expended have been determined, a strategy should be developed to ensure that follow-up will be successful. The organization of follow-up includes: (1) a systematic approach to achieving the desired benefits; (2) a method for administering the required activities (which could involve coordination of several agencies or jurisdictions); (3) clarifying responsibilities at the operational level; and (4) fostering accountability.

It is clear that there is only so much that managers can do to respond to the above noted points. In the absence of a coherent framework for follow-up activities, there may be little that even the best planner can do regarding, resourcing, accountability and auditing.

Considerations for Improving Follow-up in Environment Canada

This section discusses five main considerations that have been identified for improving the planning and management of follow-up in Environment Canada.

<u>The Need for Increased Project-Related Fieldwork</u>

Surveillance and monitoring programs maintain the Department's "credibility through service", and its position as the lead agency for environmental protection.

Maintaining credibility is particularly important for building effective partnerships with other environmental agencies. Environmental staff in agencies responsible for projects almost unanimously attest to the need for support from Environment Canada to enhance their own credibility within the management hierarchies. This support is most effectively provided through strong advisory and regulatory activities, and critical analyses of agency, company and industry performance. In the final analysis, the success of Environment Canada's advocacy program is directly dependent upon the strength of the Department's activities in the field.

The Need to Coordinate Follow-up Activities

Any means of clarifying and coordinating the follow-up activities for a development project contributes to implementation of recommendations. This can be achieved in a variety of ways appropriate to various types of projects. For large, complex projects, for example, post-assessment committees can coordinate the follow-up activities of different agencies and jurisdictions, thereby increasing their impact and cost effectiveness. Also, environmental protection plans can be useful if they address the recommendations from the assessment phase and indicate how the environmental issues are to be dealt with at the various stages of project development.

To date, the use of such coordinating committees and environmental protection plans has been the result of special circumstances surrounding individual projects. In the Western Region of Public Works Canada, however, the use of environmental protection plans was developed as the standard procedure. These plans translate the data and concerns from project assessments into concrete directions which are incorporated into the various stages of overall project management. The implementation of and follow-up to recommendations are greatly facilitated.

> The Environmental Protection Plan should not necessarily be considered a report/document type of requirement but rather should be indicative of the process of interaction which should ideally take place throughout the development of every project. In certain cases a report format is desirable, while in others a series of activities including meetings, memos, supplementary studies, etc., might be undertaken in the absence of a post-assessment document to explain them. A document however, provides a convenient way of normalizing such post-assessment activities within

> the development process as well as providing a single source of evidence that mitigating actions are in fact being pursued (Shinner, pers. comm.).[13]

The use of follow-up committees, environmental protection plans and any other means available for coordinating follow-up activities should be considered when establishing a follow-up framework, and should be promoted within Environment Canada and throughout the government.

The Need for Improved Information Management

Information management is of prime importance to successful follow-up. There are two important aspects: (a) the correct information must be generated; and (b) the information must be available. As previously mentioned, surveillance, monitoring and evaluation are complicated and at times rendered impossible if changes to project design that occur subsequent to environmental review are not recorded and made available to those doing follow-up. It is fairly common for minor changes to occur, being decided on-site by project management, and major changes are not rare. If the project as it is built differs significantly from what was described in the assessment phase documents, follow-up will be complicated unless additional documentation is provided (Bisset, 1980).[14]

One means of addressing this issue (i.e., of generating the correct information) is the production of an environmental "as-built" document, analogous to the as-built drawings produced by construction engineers and architects. The actual environmental interactions of the project as implemented would be summarized for subsequent reference during follow-up. Such a summary could include a point-by-point treatment of the environmental protection plan, where one is used, and need not be an onerous task. Environmental "as-builts" of projects have been prepared as standard procedure by NOVA, among others (Mason, pers. comm.).[15]

The reports of the environmental coordinators involved in several large projects, such as the Shakwak Highway development (Pederson, 1982),[16] contained such information. Broader and more consistent application of this type of reporting should be encouraged throughout the federal government. If the "environmental as-built" concept was instituted, a means would be needed to determine which projects required such attention. Also, funding and information storage would have to be considered.

The Need to Improve Accountability and Auditing

The federal government's experience with auditing (of the type referred to in this paper) has been predominantly through contracted studies. It is commonly and justifiably thought that audits (in general) can be done effectively by a group external to the organization being audited. This attitude was only partly corroborated by a recent investigation of environmental auditing in the private sector (Reed, 1984a, b).[17,18] It was found that auditing need not be performed by a group entirely unassociated with the organization: it is sufficient if the auditors are simply not the same people who perform the functions being audited. In addition, it can help an audit if the auditors have familiarity with the overall organization in which the function to be audited takes place. Thus, auditing by federal departments need not be, and perhaps should not be performed by contracted consultants, but rather should be part of standard departmental practices.

The Need for Follow-up as an Integral Part of Operational Plans, Work Plans and Job Descriptions

The basic system of accountability in federal departments exists in the management framework provided by operational plans, work plans and job descriptions, upon which performance appraisals are based. This management framework defines what is to be done by individuals and by every level of organization. For the performance of follow-up to be enhanced, it must be effectively incorporated into this management framework.

At the present time, it would be impossible to accommodate a comprehensive follow-up program within this management framework in Environment Canada. Follow-up, in general, is not performed with consistency, and some types of follow-up are not performed very often. There is not enough information on which to estimate the budget and personnel time requirements of such a program for inclusion in the plans and job descriptions. Also, administrative arrangements are required regarding, for example, information management and the location of responsibilities for certain types of follow-up. Further study is required in these areas, and changes to the status quo should be phased in gradually. Pilot projects in which increased follow-up activity is monitored for cost-effectiveness and administrative implications would be a valuable contribution in the near future.

Conclusions

Advocates and practitioners of EIA are involved in a process of societal change. In the fifteen years since this process became recognized in Canada as a useful development planning tool, most emphasis has been placed on instituting EIA as a common practice at the front-end of project planning. Those efforts have not been uniformly successful, but much has been achieved in fifteen years.

Nations where EIA has became institutionalized (such as Canada and the United States), are now experiencing an evolution of issues. From being concerned about "front-end" planning aspects, which are now more or less in place, they are now coming to grips with follow-up: the use to which environmental information and recommendations are actually being put during project implementation, with subsequent feedback of results to improve the system itself and the quality of the information provided. Such issue evolution is to be expected as changes occur in attitudes toward development.

Societal changes take time. EIA programs and legislation have slowly brought about real changes in the way projects are planned. It is suggested, however, that this process is unproductive unless follow-up also takes place. Follow-up provides the systemic feedback needed to make environmental impact assessment relevant and accepted as the normal way of doing things. It is now time for governments to incorporate follow-up into the system.

The specific conclusions of this paper are as follows:

1. In Canada, environmental follow-up to federal projects by environmental agencies is very important. It is one of a relatively limited range of means, outside the developer's organization, for technical quality assurance.
2. The study of cases shows that early preparation for and goal-orientation of follow-up activities facilitates their ease and success, and increases the benefits derived. This is especially true for complex or high-profile projects.
3. Many good examples of techniques and procedures exist and there are useful analyses of problems and issues, all of which can aid in the planning of particular types of follow-up (surveillance, effects monitoring, evaluation and auditing).
4. While the performance of the technical follow-up is neither uniformly straightforward nor without problems, the main reason for the existing

shortcomings is the lack of meaningful accountability and auditing by federal agencies of Environmental Assessment and Review Process activities. A recent series of studies by Environment Canada (1980) found that the coordination and execution of these activities, government-wide, was unacceptably inconsistent.[19] With meaningful auditing, this situation would improve. It is recommended that the accountability and auditing system for EARP activities in Environment Canada be upgraded, and that similar initiatives throughout the government be advocated.

5. The solution of information management problems is also basic to improving the ability to do follow-up. Recording of relevant and up-to-date environmental information on projects, from the proposal stage to implementation, should be standard practice in cases where monitoring or evaluation are planned or likely. It is concluded that an administrative system is needed for deciding when such records are necessary, for providing funds, and an information registry. Within Environment Canada's organizational structure for the delivery of EARP-related activities, opportunities exist for improving information management and addressing the above-stated needs. The author recommends that these opportunities be investigated, and the need for improved government-wide information management be advocated vigorously by Environment Canada.
6. Throughout the government, there is a need to establish frameworks to guide managers in the preparation for and performance of follow-up. This must be established as a priority, especially in Environment Canada.
7. A review of process management and of EIA overall in Environment Canada, is recommended, with consideration given to the factors noted herein that affect the ease and success of follow-up.
8. Increased field activity by Environment Canada staff would maintain and enhance the credibility of the Department as the federal environmental advocate. Follow-up plays a crucial role here. It is recommended that Environment Canada explore means of allocating more resources to fieldwork and follow-up.
9. Since the performance of follow-up is inconsistent in the federal government, there are significant information gaps that must be filled before a comprehensive organizational framework can be developed and instituted in Environment Canada and other federal departments. Increased follow-up

activity should be introduced in stages to allow determination of cost-effectiveness, organizational implications and optimal procedures.

10. It is recommended that environmental agencies immediately plan and implement phased programs to increase cost-effective follow-up. The initial steps should be simple to implement. One possible initial pilot project would see environmental agency staff encouraged to follow up their own work on an individual basis. In Environment Canada, for example, whenever advice is provided, through whatever forum, the staff involved could try to find out for themselves whether or not it was heeded, whether or not it was effective, and why. Another possible pilot project would see selected Environment Canada offices funded to perform a reasonable overall follow-up program, including surveillance, monitoring, evaluation and auditing. The program would be closely scrutinized to identify further pilot project options.

NOTES AND REFERENCES

1. For a detailed description of the Process, refer to the "Revised Guide to the Federal Environmental Assessment and Review Process", available from the Executive Chairman, Federal Environmental Assessment Review Office, Hull, Quebec, Canada, K1A 0H3.

2. Throughout this document the terms "assessment" and "assessment phase" are used in the limited sense, referring to the stage when the environmental impacts of a proposal are predicted and plans are prepared to mitigate such impacts where necessary. The environmental management of a proposal/project beyond this stage (including follow-up as defined in this paper) is referred to as being "post-assessment", or coming after the assessment. Other authors have used "assessment" or "environmental impact assessment" in a broader sense, to refer to the overall environmental management of a proposal/project, and to include the measurement of the actual environmental impacts of a project.

3. For projects receiving only initial assessment, the initiating agency (the agency responsible for federal decision making regarding the proposal) is to ensure that mitigation and compensation measures are implemented by the proponent (the industry or federal agency actually undertaking the project, which may or may not be the same group as the initiating agency). Thus, for what is the majority of cases, the follow-up requirement is limited to surveillance. For the minority of projects (those that receive formal public review) the initiating agency is to ensure that Ministerial decisions resulting from the Panel Report are "...incorporated into the design, construction and operation of that proposal and that suitable implementation, inspection and environmental monitoring programs are established..." (Canada Gazette, Part II, July 11, 1984, pages 7-8). The proponent, in this minority of cases, is to

"...ensure that appropriate post-assessment monitoring, surveillance and reporting, as required by the initiating department, are carried out" (Canada Gazette, Part II, July 11, 1984, page 8). See also note No. 7.

4. The term "environmental agency" is used in this paper to refer to any group in the government (department or part thereof) that: (1) provides data and/or advice to those doing assessments; (2) enforces environmentally related regulations; or, (3) has a mandate to advocate environmental concerns.

5. Environment Canada has been directed under the Government Organization Act, 1979, "...to promote and encourage the institution of practices and conduct leading to the better preservation and enhancement of environmental quality. The Act states that: "the duties, powers and functions of the Minister of the Environment extend to and include (a) all matters over which the Parliament of Canada has jurisdiction not by law assigned to any other department...relating to the preservation and enhancement of the quality of the natural environment...". In those cases where the Department of the Environment does not have legislative authority for a particular matter related to the environment, the Minister is directed to advise the heads of the responsible agencies "...on all matters pertaining to the preservation and enhancement of the quality of the natural environment" (Government Organization Act, 1979). To address this responsibility the Environmental Protection Service developed the Environmental Quality Policy under which the Service seeks to "...ensure that human activities are conducted in such a way which will achieve or maintain a state of the environment necessary for the health and well-being of man, diversity and health of ecosystems, and the sustained use of natural resources for social and economic benefit".

6. McCallum, D.R., "Environmental Follow-up to Federal Projects". Draft report for Environmental Impact Systems Division, Environmental Protection Service, Environment Canada, 15th Floor, Place Vincent Massey, Ottawa, Ontario, K1A 1C8, December 1984, 107 pages.

7. The only statements addressing auditing in the Order-in-Council that define the Process ("Environmental Assessment and Review Process Guidelines Order". Canada Gazette, Part II, July 11, 1984) are in Sections 16 and 18:

   (1) Section 16. Regarding initial assessment, the initiating department "...shall provide the Office (FEARO) on a regular basis, with information, on its implementation of the Process with respect to the proposals for which it is the decision-making authority".

   (2) Section 18. "It is the responsibility of the Office (FEARO) to... (d) inform the Minister (of the Environment) on a periodic basis, in a report to be made public, on the implementation of the Process by initiating departments".

   FEARO has used these sections to support the requirement, noted in the text of this paper, which enables them to report annually to the Minister of the Environment on the decisions taken in initial assessment. FEARO has asked initiators essentially for the number of decisions taken, whether they were for or against the proposal, with or without mitigations, and at what stage in initial assessment the decision was made.

There is no provision in the Order-in-Council for auditing of the role of the advisors (such as Environment Canada) in initial assessment, the performance of any of the actors in public reviews, nor the role of FEARO in overall administration of the Process.

8. Environment Canada, a series of reports entitled: "Environment Canada, A Review of the EARP Concerning the Advisory Role of DOE/RSCCs as of June 30, 1982", 21 pages plus 5 appendices; "Program Evaluation of the Federal Environmental Assessment and Review Process (EARP) in the Federal Environmental Assessment Review Office (FEARO)", 31 pages plus 2 tables and 4 exhibits; "The Environmental Assessment and Review Process in Public Works Canada", 29 pages plus 7 exhibits and executive summary; "Program Evaluation of EARP in EMR", 39 pages plus executive summary; "Evaluation of the Federal Environmental Assessment and Review Process (EARP) in Indian and Northern Affairs", 31 pages plus 12 appendices and executive summary; "A Program Evaluation of the Federal Environmental Assessment and Review Process (EARP) in the Department of National Defence", 34 pages plus 18 appendices and executive summary; "The Environmental Assessment and Review Process in the Department of Transport", 39 pages plus 1 appendix and executive summary. Evaluation Branch, Planning and Evaluation Directorate, Corporate Planning Group, Environment Canada, Terrasses de la Chaudière, Ottawa, Ontario, K1A 1G2, June 1982.

9. Parks Canada, "Manual on the Application of the Environmental Assessment and Review Process Within Parks Canada". Parks Canada, Environment Canada, Terrasses de la Chaudière, Ottawa, Ontario, K1A 0H4, 1981.

10. For those interested, the case studies are discussed in the draft report: McCallum, D.R., 1984, op. cit.

11. McCallum, D.R., Ibid.

12. McCallum, D.R., "Planned Follow-up: A Basis for Acting on EIAs". Paper presented at the annual conference of the International Association for Impact Assessment, Utrecht, the Netherlands, June 27-28, 1985, 12 pages.

13. Letter from N. Skinner, Regional Environmental Coordinator, Architectural and Engineering Services, Western Region, Public Works Canada to the author, 28 March, 1984.

14. The problems created for follow-up by inadequately described projects, and by projects whose designs have changed following the assessment phase are discussed further in a paper by R. Bisset: "Problems and Issues in the Implementation of EIA Audits". Environmental Impact Assessment Review, Vol. 1, No. 4, December, 1980, pages 379-396.

15. Personal communication, C.P. Mason, Manager, Environmental Affairs, NOVA an Alberta Corporation, P.O. Box 2535, Station M, Calgary, Alberta, T2P 2N6, Canada, 1985.

16. For a description of the project and the reports mentioned, see: Pederson, R.C., "Post-Construction Study of the Shakwak Highway Environmental

Assessment Review". Masters Thesis, Faculty of Environmental Design, University of Calgary, 2500 University Drive, N.W., Calgary, Alberta, T2N 1N4, 1982, 173 pages plus 1 appendix.

17. Reed, J., "Environmental Auditing - A Review of Current Practice", Manuscript Series No. IP-17, Environment Canada, Environmental Protection Service, Place Vincent Massey, Ottawa, Ontario, K1A 1C8, 1984.

18. Reed, J., "Environmental Auditing in the Canadian Private Sector", Manuscript Series No. IP-18, Environment Canada, Environmental Protection Service, Place Vincent Massey, Ottawa, Ontario, K1A 1C8, 1984.

19. See Environment Canada, 1982, op. cit.

APPENDIX 1:
SOME POTENTIAL BENEFITS FROM FOLLOW-UP

Surveillance:

- environmental protection enhanced
  - projects built according to plans
  - provides a base for monitoring and evaluation
  - allows plans to be altered to address site conditions and altered project design
  - increases potential involvement in contract change negotiations
- learning opportunity for staff
- interagency relations improved
  - expectations mutually clarified
  - can increase cooperation with other reviewers through sharing of surveillance information
- improves credibility
  - increases success of advocacy
  - increases in-house power of the proponent environmental staff
- contributes to auditing

Effects Monitoring:

- identifies unforeseen or incorrectly predicted impacts
- allows adjustment of mitigations
- provides a basis for evaluations
- can contribute to assessment of cumulative impacts and latent or threshold effects
- can contribute to knowledge of ecosystem structure and function

Evaluation:

- technical improvement of mitigations and environmental prediction making
- applies pressure to improve practices
- constructive, pragmatic input enhances review agency credibility

Auditing:

- encourages compliance and better work by developers
- increases the effectiveness of management
  - policy development
  - procedural adjustments
  - identifies degree to which responsibilities are discharged
  - improves efficiency of resource use
- identifies needs for training and personnel development
- improves success of advocacy
- guides future interactions with other agencies
- improves overall credibility

IMPLEMENTATION OF ENVIRONMENTAL IMPACT ASSESSMENT RECOMMENDATIONS: THE ROBERTS BANK PORT EXPANSION EXPERIENCE

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Introduction

Experience with the implementation of the recommendations of the Roberts Bank Environmental Assessment Panel has provided a variety of lessons on the linkages between environmental assessment, implementation and monitoring, and the means for ensuring their timely consideration. Two areas have been chosen to highlight some of these lessons: (1) committee responses to predicted and unexpected impacts; and (2) organizational factors necessary for effective committee operation.

The observations presented in this paper may appear to be statements of well recognized environmental management or organizational principles and techniques. In many cases they are. However, experience shows that it is attention to the details and the basics that will in large measure determine the effectiveness of an implementation program. By illustrating some key aspects of Roberts Bank Environmental Review Committee performance, it should be possible to improve the design and management of similar activities in the future.

Project Setting and Background

Roberts Bank is a vast intertidal mud flat at the mouth of the Fraser River and, as such, forms a considerable part of the biologically important Fraser River estuary (Figure 1). In 1969, the Port of Vancouver constructed a 20 hectare coal terminal at the seaward edge of Roberts Bank. The terminal was connected to the shore by a 5 kilometre causeway some 30 metres in width.

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* The observations and recommendations presented in this paper are those of the authors and are not intended to represent the views of either the Roberts Bank Environmental Review Committee or the B.C. Ministry of Environment.

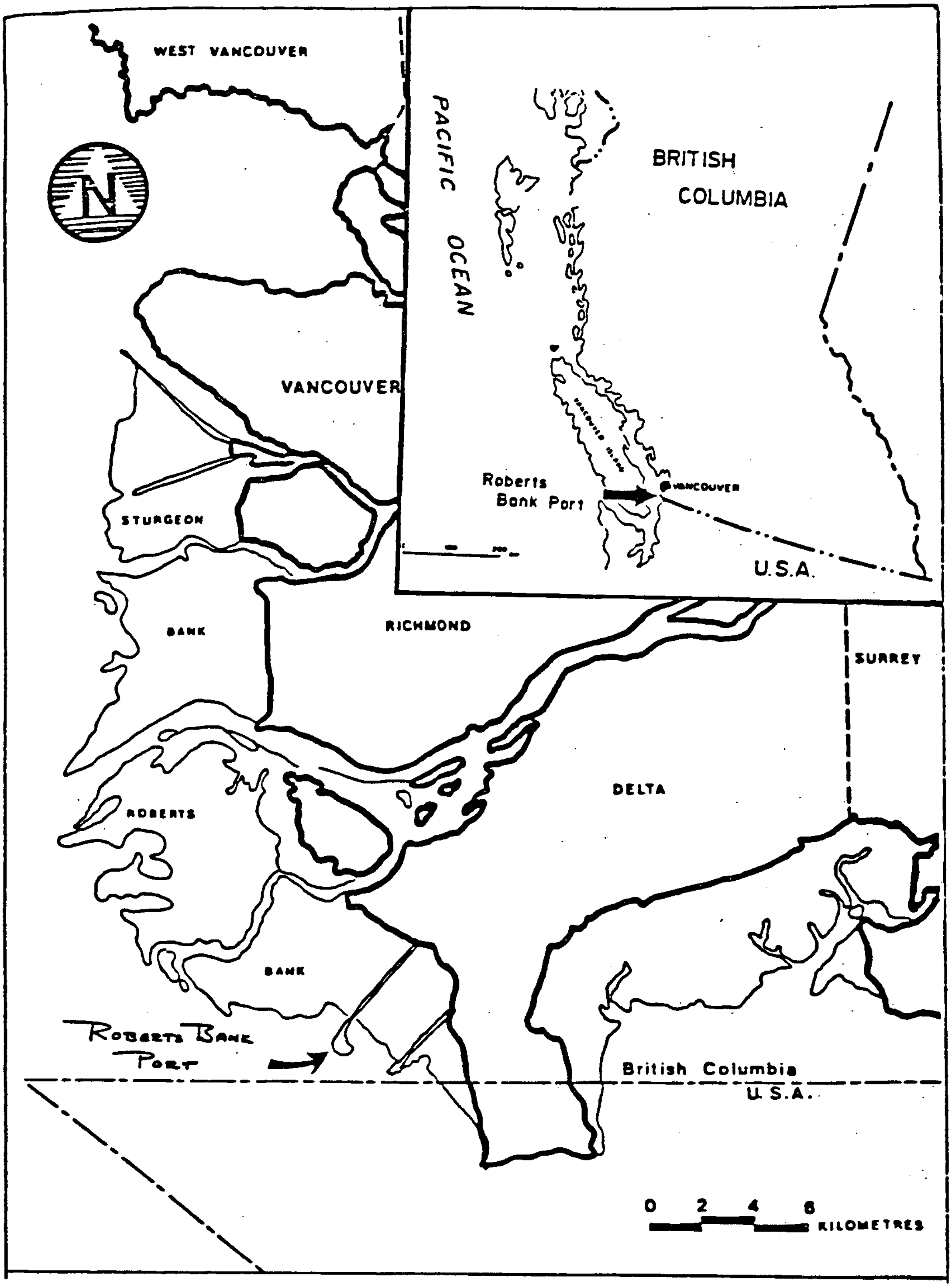

FIGURE 1 GENERAL LOCATION MAP

In response to perceived need, the Port of Vancouver undertook an extensive evaluation of potential sites for additional bulk shipping facilities in 1977. As the Port of Vancouver is a federal crown corporation, the proposed expansion of its Roberts Bank facility was subject to the federal Environmental Assessment Review Process. The environmental impact assessment (EIA) for the Roberts Bank port expansion was completed in six months and runs to nearly 1000 pages in length. This weighty document (5 kg) was subjected to public scrutiny during a series of hearings in 1978. The report of the Environmental Assessment Panel was released in March, 1979.

A major recommendation of the Environmental Assessment Panel was that "the federal department of Environment take the initiative to organize the monitoring of the implementation of the recommendations of this Panel, and the requirements of the various levels of government." To that end, the Department of Environment (DOE) organized the Roberts Bank Steering Committee consisting of DOE, the National Harbours Board (Port of Vancouver), the Department of Fisheries and Oceans, and the provincial Ministry of Environment. This committee served to coordinate environmental input to the planning and design phases of the proposed expansion from the time of release of the Panel report until the signing of the federal/provincial land transfer agreement for the port expansion in August, 1980. Under this agreement, the Port of Vancouver agreed to construct the expansion "substantially in accordance with" the report of the Environmental Assessment Panel. This agreement also specified that a committee to be known as the Roberts Bank Environmental Review Committee (RBERC) would make recommendations on the implementation of the Panel report to the Port of Vancouver. The Steering Committee subsequently became the Environmental Review Committee with the addition of representatives from the local municipality (Corporation of Delta), and the adjacent landowner (B.C. Harbours Board).

Construction began in September, 1981. Sediments dredged from the adjacent ship channel were used to create three 20 hectare pods and to widen the causeway to 100 metres. Dredging and filling operations were completed in June, 1983. Environmental studies were conducted throughout the construction period. Follow-up studies to measure the actual effects of project development are continuing.

Four Lessons in Environmental Management

Environmental Impact Assessment and Panel Recommendations

As noted, the Roberts Bank Environmental Review Committee was formed to oversee the implementation of the nineteen Panel recommendations which, significantly, covered a very broad range of topics. The Committee has acted upon all nineteen recommendations. To date, some seventeen have been fulfilled. It is noteworthy that the only areas where significant progress has not been achieved concern two recommendations which could be considered outside the immediate influence of the Committee. One Panel recommendation was that public lands adjacent to Roberts Bank be transferred to a provincial agency with a clear agricultural mandate. The provincial government has not taken any action on this recommendation thus far. Similarly, there has been almost no action on the Panel's recommendation that appropriate government agencies undertake additional biological studies on Roberts Bank. One might conclude that Panel recommendations calling for "more study" can be more readily accommodated if they bear existing agency research priorities in mind. In a more general sense, it is useful to recognize that recommendations like the above two must ultimately fit into the priorities and capabilities of existing government programs and policies before they are likely to be acted upon.

The EIA for the port expansion contained sixteen technical recommendations to avoid or minimize environmental disruption. In reviewing these, we were surprised to find that the Committee has fulfilled fifteen of the sixteen recommendations. The reason for surprise is that this has been accomplished without direct reference to the EIA. There was little overlap between the EIA and Panel recommendations. Only eight recommendations were common to both documents. Interestingly, the Committee has fulfilled all eight of the common recommendations and nearly 90% of the total recommendations.

Committee Response to Selected Recommendations

As an implementation mechanism, the Committee has had to deal with a wide range of both predicted and unexpected impacts resulting from the port expansion. The following four examples have been chosen to illustrate the breadth, depth and flexibility of the Committee's deliberations and actions.

The first example is a predicted impact which failed to materialize. Both the EIA and the Panel reports recommended costly mitigation measures to reduce bird mortalities from collisions with overhead wires and stanchions along the causeway and at the terminal. These recommendations were based largely on six months of data collected for the EIA. In considering this recommendation, the Committee decided that data covering a full annual cycle were needed before action could be taken. A study was commissioned and the results showed that overall bird mortalities were not significant. As a result, no mitigation measures were required. The fact that the Committee was not tied to a rigid interpretation of a Panel recommendation and was able to conduct a more detailed investigation resulted in a considerable cost saving.

The second example is a major environmental impact which was not predicted during the assessment process. The dredging operation removed approximately 13 million cubic metres of sediment from the new ship channel and turning basin. Approximately 10 million cubic metres was deposited as fill material in the new pods and expanded causeway. The remaining 3 million cubic metres was discharged as overflow onto the adjacent intertidal sand flats, in deposits up to 3 metres thick. One impact was the burial of about 90 hectares of eelgrass beds.

A drilling program conducted before dredging began indicated that only 10 percent of the material would be unsuitable for fill. It was thought that this excess material would be washed offshore. In fact, more than 20 percent turned out to be unsuitable. Furthermore, it has turned out to be much more stable than was predicted. Had this information been available beforehand, the Committee could have made use of the overflow material as part of a habitat compensation program. As soon as the Committee became aware of the overflow problem, it implemented two monitoring programs to measure the areal extent and stability of the new deposits. This work is continuing. At present, it appears that some of the material will need to be relocated, at considerable additional expense, if it is to contribute to the habitat compensation package. The two lessons to be learned are that accurate baseline information can reduce costs in the long run and that post-construction monitoring can be useful for altering future actions.

The third illustration deals with a mitigation measure which was implemented to avoid a major impact predicted in the EIA. During the assessment investigations, it was discovered that a borrow pit excavated for the original terminal was causing severe erosion of the surrounding eelgrass bed. Because dredging for the port expansion would extend into existing eelgrass beds, an erosion control structure was designed for the perimeter of the dredged basin. The structure was built at a cost of $1.5 million. Follow-up studies have revealed that erosion has not only stopped but has been reversed in some of the old erosion channels which are now covered by eelgrass. However, several areas where new channels appear to be forming are being monitored closely to ensure that a new problem has not merely been substituted for an old one. Obviously, there can be considerable value in monitoring the effectiveness of a mitigation effort.

The final example relates to an initiative by the Committee which was only touched upon in the EIA and which received little attention in the Panel report. The Committee has tried to meet the Department of Fisheries and Oceans' working principle of "no net loss of habitat" for the Roberts Bank port expansion project. The excavation of a 90 hectare turning basin and ship channel, and the burial of 115 hectares of intertidal sand flat has resulted in a significant loss of habitat. However, other changes such as the use of riprap and pilings have increased benthic habitat. The Committee's approach to addressing this issue has been to tally a balance sheet containing both losses and gains based on the common denominator of net annual carbon production.

Initial estimates of the losses and gains have been refined through as-built measurements and further consideration of appropriate productivity rates for the various affected habitats. It is interesting to note that these subsequent adjustments have not significantly altered the initially calculated net loss figure. In retrospect, it is recommended that a first cut of a habitat loss figure be made early on in the planning process and that potential means of addressing the loss be proposed. In this manner, opportunities such as the overspill of dredge sediments noted in lesson 2 can be more readily incorporated into a compensation program during construction when equipment and manpower are available.

Assessing RBERC's Effectiveness

Assessment of the effectiveness of the Roberts Bank Environmental Review Committee is hampered by the lack of previous similar evaluations. Although inter-agency and proponent coordination regularly occurs at the assessment phase of project development, the Roberts Bank expansion is a forerunner in British Columbia for using this approach to implement the recommendations of an environmental impact assessment. Consequently, RBERC was unable to benefit from the experience of previous applications and this paper is unable to build upon the analysis and conclusions of previous evaluations.

It is, however, possible to identify some key factors in the operation of an inter-agency committee and to use them as a means of assessing the effectiveness of the RBERC approach. Based on a previous review of the literature on the design and management of inter-agency resource management committees for an evaluation of administrative factors in estuary planning, three themes have been selected for assessment: goals and objectives, committee composition, and committee coordination (Morgan, 1983). For each of these factors, there will be a brief statement of its generic importance in committee design and management, how it was accounted for in structuring and operating RBERC, and the effectiveness of the approach applied.

Goals and Objectives

Role in Committee Design and Operation

The goals and objectives of the committee will serve as the basis for all actions taken during the implementation of the environmental assessment recommendations. They will be the primary means by which each participating group will relate the goals and objectives of their organization to the implementation effort. Accordingly, each goal must be accepted by all participants as the basis for cooperation. To achieve this commitment to the goals and objectives, it has been suggested that each party must participate in their development (Stern, 1971, 87).

Scanlin (1973, 47) notes that a common set of goals and objectives serves many purposes. They:

1. secure consistency of action throughout the organizational system;
2. act as a basis for future actions and decisions;
3. ensure coordination of task plans;
4. require control of performance in terms of the task plans;
5. provide a means by which authority can be delegated;
6. preserve or enhance the morale of participants; and
7. stimulate the participants to greater efforts and sustain cooperation in difficult times.

Without the direction provided by an agreed upon set of goals and objectives, the implementation process can deteriorate into an amalgamation of individual efforts rather than a truly integrative effort. Consequently, goals and objectives should be viewed as an integral component of the approach to implementation.

RBERC Application

Given that the responsibility of RBERC was to implement the recommendations of the Environmental Assessment Panel, an environmentally sound expansion can be seen as the overall goal and the recommendations as the specific objectives of the Committee. There are a number of characteristics regarding the development and implementation of these 'goals and objectives' that should be noted.

As in the case of many environmental impact reviews, the assessment and implementation phases of the Roberts Bank expansion project have been conducted as largely independent activities. Consequently, the individual participants, with one exception, changed in the transition from assessment to implementation responsibilities. As a result, RBERC was assigned the task of overseeing the implementation of another committee's recommendations.

The question of 'ownership' or commitment to the recommendations has been addressed by RBERC in a number of ways. Consistent reference to the recommendations has been made throughout the implementation phase. For example, they were used as a means of documenting Committee efforts in the December 1983 Progress Report. However, RBERC has not perceived the recommendations as binding and has interpreted some and added others as implementation has proceeded. This flexibility of approach has permitted the 1979 recommendations of the Panel to be honed to the realities of construction between 1981 and 1984 and to the results of subsequent monitoring and mitigation activities. Consequently, the Committee has been implementing refined recommendations in the context of the experience and circumstances of project implementation and monitoring.

The objectives of RBERC were not consistently translated into terms of reference of work plans to guide their achievement. An activity schedule outlining the progression of tasks for major activities was prepared at the request of the Committee, but did not serve as a major force in assessing progress or directing effort. As a substitute for overall, long term direction, specific guidance on priorities and required actions was provided at Committee meetings. Although this type of direction generally kept the activities rolling, it often did not provide an opportunity to reflect on whether an activity was going to contribute to the achievement of an objective or how it related to other ongoing or proposed initiatives. In some cases this ad hoc approach to decision-making resulted in an activity that did not contribute effectively to its objective.

RBERC Effectiveness

The Roberts Bank Environmental Review Committee has used the recommendation of the Roberts Bank Environmental Assessment Panel as objectives to guide its activities. By refining the recommendations to the realities of the project during the construction and post-construction periods, RBERC has increased the usefulness of the recommended actions and improved the linkage between projected impacts and responsive mitigation. Being able to adjust its activities on the basis of monitoring results and general experience has enhanced the effectiveness of RBERC in managing the impacts of the port expansion. Flexibility to interpret and refine EIA results and recommendations is seen as an essential element of effective implementation.

To achieve the diverse range of objectives for which RBERC was responsible, coordination of effort and clear designation of responsibilities was required. The failure to prepare work plans to specify responsibilities and tasks resulted in uneven progress toward achieving the objectives and, at times, did not highlight the important linkages between many of the activities. Too often activities were performed in the absence of a clear understanding of their relationship to the overall objective to which they were intended to contribute. The preparation and ratification of work plans for each objective would have forced more consideration of the linkage between the objectives and individual activities.

Team Composition

Role in Committee Design and Operation

The approach to implementation of environmental impact assessment recommendations selected for the Roberts Bank expansion project involved a variety of government agencies and private interests. Consequently, numerous individuals of varying academic and professional backgrounds (e.g., engineers, biologists, geographers) were brought together to perform inter-related tasks. The basic challenge in organizing an interdisciplinary committee is to first recognize and then coordinate the varied contributions that each team member can make. Alonso (1971, 169-173) observes:

> The team brings together members of different intellectual species, and some of these species rarely mix. They will use words differently, attribute different importance to various aspects, and have different views of their own and others' competencies and interests.

> The ability of the organizational structure to blend these varied perspectives through the provision of competent leadership directed toward common goals and objectives, will, in large measure, determine the success of the implementation effort.

RBERC Application

The primary criterion for the selection of RBERC members was the ability to implement the Assessment Panel's recommendations, either as a government agency with a regulatory responsibility or as the proponent. The Department of Environment, Department of Fisheries and Oceans, Ministry of Environment, and the proponent, National Harbours Board were the original members of the committee. This group was subsequently expanded to include the Corporation of Delta (local municipality) and the British Columbia Harbours Board (provincial landowner). Upon dissolution of the Harbours Board and distribution of its assets to B.C. Rail and the B.C. Development Corporation, both of the new parties joined the Committee.

Various members of the committee have supplemented the expertise available at meetings by inviting agency staff or proponent consultants to attend when specific issues were going to be discussed. For example, the proponent's project engineering consultant regularly attended meetings during the final design and construction phases to report on progress and to respond to specific questions from committee members. Having direct access to pertinent expertise proved to be of considerable benefit to the committee.

RBERC Effectiveness

As noted previously, the Environmental Assessment Panel's recommendation covered a wide range of potential impacts, not all of which were directed at the proponent, the National Harbours Board. Consequently, an important determinant of RBERC effectiveness has been the ability to bring the major interests together to cooperatively proceed with implementation.

From the outset, RBERC has been cognizant of the need to include all relevant parties in its deliberations. The addition of the Corporation of Delta and the B.C. Harbours Board (subsequently B.C. Rail and B.C. Development Corporation) to the committee reflects this recognition. Having the involved agencies and the proponent present at the table has been seen as the most effective method of encouraging action and presenting all sides of an issue. Despite the frustration of spending time and effort on issues of no interest to a given agency, the benefits of an open forum for issues to be discussed and resolved from a variety of perspectives have been apparent.

The Committee's high level of response to the recommendations indicates that the right agencies were selected to guide the implementation effort. In the majority of cases, the mandate to effect the required action was represented on the

Committee. Representation of the responsible agency does not guarantee action, but it is an important first step. The Committee has experienced greater difficulty in trying to influence the actions of 'outside' agencies than it has with its members. In large part, this is a reflection of a lack of understanding of the role and responsibilities of RBERC by non-members and uncertainty regarding how the Committee's mandate affects their regulatory or management responsibilities.

Commitment to the activities of the committee by each member is crucial to its successful operation. Although commitment is a difficult concept to measure, regular meeting attendance, low turnover of agency representatives and efficient performance of committee assignments all contribute to dedicated and effective participation. In the case of RBERC, the efforts of the representatives and their agencies in keeping changes in committee membership to a minimum have proved to be particularly valuable. The committee has been able to build on previous decisions and understandings on a regular basis and has had to spend little time familiarizing new representatives.

The active participation of the proponent, the Vancouver Port Corporation, in dealing with the activities of the RBERC, has been particularly valuable. It has made a major contribution to the achievements of the committee. Central to this commitment and success has been the $1.5 million budget assigned to respond to the Panel recommendations.

Committee Coordination

Role in Committee Design and Operation

In large scale projects or when developing environmentally sensitive areas, the complexity of issues often requires the involvement of a number of participants with varying mandates and interests. To maximize their contribution and to ensure that all issues are responsibly addressed, coordination of their effort is essential. Despite the recognition of this need, arrangements to ensure that coordination occurs are often overlooked. Our experience with RBERC suggests that coordination will not happen on its own; specific attention must be paid to creating the right conditions. To effectively guide the committee's activities toward the achievement of its objectives, arrangements for the exchange of information and the provision and receipt of instructions must be developed and used. Without these arrangements, the implementation process can become a series of individual efforts rather than a coordinated endeavour.

RBERC Application

Two major areas of coordination have been observed: internal coordination of the activities of the Committee; and coordination within each participating agency. Internal committee coordination of activities has been approached in two ways. For the first two years, coordination was the shared responsibility of the members, with the chairman assuming the predominant share of overall management duties. During this period, the concept of a 'lead agency' in each major area of committee involvement developed. For example, Fisheries and Oceans Canada took the early lead in developing an approach to habitat compensation. The risk associated with this approach is that the lead agency will tailor the activities to its own specific requirements rather than the broader needs of the committee. Secondly, the rest of the committee may remove itself from active participation in the activities of the lead agency and provide only passive guidance. Both of these situations began to develop over time and were in part responsible for the hiring of an environmental coordinator. More significantly, however, as implementation proceeded, the Committee's activities increased and the burden of coordination became too great to handle in a casual manner and required more formal and rigorous response. An environmental coordinator was contracted to serve as a single point of coordination of committee activities. This marked the beginning of the second phase of committee coordination.

The coordinator works out of the office of the proponent, the Vancouver Port Corporation, but reports to the chairman of RBERC. The assigned or assumed responsibilities cover a wide variety of functions, ranging from recording and distributing meeting minutes to producing technical reviews of committee sponsored projects. The range is determined by the qualifications of the individual and the desires of the committee; in the RBERC case these were both broad and resulted in considerable scope for the coordinator and beneft to the committee.

Coordination within each agency is the responsibility of the agency's representative on the Committee. An underlying premise of the Committee's operation is that each representative is able to speak for, and make decisions on behalf of, his agency in relation to the Roberts Bank expansion. Consequently, development of internal agency policy and positions regarding the various aspects of the project is required. The regionalization of operational decision-making within some agencies makes this need more important. Both the B.C. Ministry of Environment and the federal Department of Fisheries and Oceans have moved in this direction and, as a result, their headquarters representatives on the Committee are responsible for obtaining input from their regional operations. From time to time, depending upon the issues being discussed, regional staff were invited to attend Committee meetings and directly participate in the deliberations.

RBERC Effectiveness

The effectiveness of the coordinative initiatives of RBERC has varied between the two types of coordination identified: internal committee and participating agency.

The key to internal committee coordination has been the implementation coordinator. When the coordinator was on staff, coordination was evident on a regular basis and progress toward the committee's objectives was apparent. During the periods when the committee functioned without a coordinator, coordination was more haphazard and progress more intermittent. There are a number of reasons for the marked differences in committee performance with and without the coordinator. Most of these relate to the simple concept that coordination of the myriad of details associated with the environmental management of a major project requires consistent, concerted effort. It would appear that one person charged with this responsibility is better able to provide the required level and consistency of effort than a group of individuals.

In part, the effectiveness of independent coordination is related to the observation that the level of interest in a particular committee initiative varied among the members according to the immediacy of that issue to their agency's mandate. As a result of this tendency, it is unreasonable to expect even coordination of all activities when there is an uneven level of interest or concern. In theory, all of the agencies are committed to all of the committee's interests. In practice, this commitment varies and should be managed accordingly. As the coordinator was working for the committee, he was able to coordinate all of the activities with the committee's objectives in mind.

Coordination within some of the participating agencies has not been as well orchestrated as the internal Committee coordination. Given the breadth of responsibilities of the Ministry of Environment, it is important that all parts of the agency are aware of the role of RBERC and conduct their activities accordingly. In the case of the waste management permits required for the expanded port facility, the responsible branch of the Ministry of Environment did not consider the broader objectives of RBERC and reviewed the application using its standard criteria. As a result, the waste management program has undergone several reviews and amendments and is still of concern to the Committee. Improved and more frequent communication on the role of RBERC and the necessary adjustments to agency decision-making would have prevented most of the misunderstandings and time delays that occurred.

Summary and Conclusions

The expansion of the port facilities at Roberts Bank has progressed through several stages of the project life cycle. Planning began in the mid-1970's, construction spanned two years (1981-1983), and one of the three new pods is now being used to ship coal. Each of these phases has had to deal with different environmental concerns and requirements. The environmental impact assessment conducted during the planning phase resulted in a list of recommendations on how project construction and operation should proceed. The report of the Environmental Assessment Panel addressed both the "whether to" and the "how to" questions. The Environmental Review Committee formed to oversee implementation of the Panel recommendations has become less of a watchdog ensuring compliance and more of an advisor to the proponent.

Experience with the Roberts Bank Environmental Review Committee has led us to conclude that it has been an effective mechanism for ensuring that the port expansion has proceeded in an environmentally sound manner. The following factors appear to be primarily responsible for the success of the approach and should be considered for incorporation in future similar exercises:

- full participation of the project proponent as a cooperative partner throughout the environmental management process;
- a sufficient ($1.5 million) budget to address the Environmental Assessment Panel's recommendations;
- the Committee's flexible interpretation of the Panel's recommendations and willingness to consider environmental concerns not addressed by the Panel;
- continuity of personnel serving as agency representatives on the Committee;
- hiring an environmental coordinator as staff support to the Committee;
- inclusion of all relevant parties on the Committee; and
- recognition of the importance of both impact and mitigation monitoring.

Final observations relate to the importance of timing. Planning for the expansion of Roberts Bank port began a decade ago. It is now eight years since the environmental impact assessment studies began. One might be tempted to visualize the Roberts Bank expansion as the "perfect project" where sufficient lead time was available to plan and conduct all facets of the ultimate environmental program. Such was not the case. After the Panel report was issued, additional studies were conducted to finalize the configuration of the expansion. Treasury Board approval was sought and various agreements had to be reached. Environmental work stopped while this was done. The construction monitoring programs were put together quickly just before dredging began. As a consequence, some of the major impacts of the expansion were missed. The environmental coordinator did not join the Committee until construction was half over. Although work on a habitat compensation program was begun well before construction commenced, there was no attempt made to dovetail construction activities with the overall needs of a compensation program. In summary, although the right ingredients were included in the environmental management program, they were often incorporated later than they should have been to achieve maximum influence.

To respond to the deficiencies associated with these lapses in timing, it is necessary to become more aware of the relationship between environmental assessment, implementation and monitoring and to treat these as a continuum rather than as independent processes. Anticipation of future needs or opportunities must be built into each stage of the process.

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ENVIRONMENTAL MANAGEMENT OF MAJOR CONSTRUCTION PROJECTS IN BRITISH COLUMBIA

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Introduction

Environmental planning for major construction in projects in British Columbia has improved substantially over the last 20 years. In the past, environmental concerns were accorded a much lower priority than engineering and economic considerations. More recently, emphasis has shifted toward the early incorporation of environmental factors into project planning. Components of the planning process which have emerged include environmental impact assessment, development of mitigative designs and procedures, and public and governmental review.

Faced with a series of potential megaprojects in the 1970s, British Columbia developed several review processes to evaluate different proposals and regulate their development. These processes included those for coal and metal mines, energy projects, and linear developments. They evolved rapidly during initial implementation but became well established in the early 1980s.

While the mechanisms for bio-physical inventory, assessment, and review are now familiar, experience has shown that they do not guarantee environmental protection during the construction phase. Attention is now being focused on improving implementation of environmental plans, therefore. Evaluation of environmental management programs developed for this purpose is now leading to more effective systems for controlling construction activities. Potentially, it also allows inventory and review phases of future projects to be streamlined by indicating the type and amount of information required for environmentally effective project design and construction procedures.

Twelve major construction projects were selected for review in this study (Table 1). The environmental management system in place for each was evaluated by examining the regulatory arrangements which applied to the project and assessing the design and implementation of the proponents' environmental program developed in response to them. By examining the implementation phase of the programs the adequacy of all components was determined.

Construction events were assessed by review of project files, where available, and by interviews with key management and regulatory personnel. In this manner, critical issues and concerns for each project were identified and different perspectives were gained on how and why problems developed and were dealt with. A qualitative determination of success or failure for each environmental program was made based on its effectiveness in resolving problems and by the degree of consensus between proponent and regulatory authorities.

It was not possible to examine all aspects of each program in detail, nor was it necessary. Most projects were marked by one or two critical issues or events which indicated the particular component of the management program responsible for success or failure. Therefore, it was possible to compare projects managed under similar conditions to determine the relative importance of each factor and to examine the relationships between them.

TABLE 1 PROJECTS REVIEWED

1.	Tumbler Ridge Transmission Line
2.	Tumbler Ridge Highway
3.	Tumbler Ridge Rail Line
4.	Kelly Lake - Nicola Transmission Line
5.	Cranbrook - Alberta Border Transmission Line
6.	North Island Highway
7.	Coquihalla Highway
8.	Coquihalla Pipeline
9.	Alaska Highway Gas Pipeline Prebuild
10.	CNR Twin Tracking
11.	Revelstoke Dam
12.	Quinsam Coal

Conclusions are drawn regarding program design and implementation. Recommendations are made for changes in existing approaches by government which will improve efficiency and effectiveness. Specific requirements for effective management programs are also provided.

Environmental Management

Components of the environmental management process can be categorized under three phases of development:

a) planning, assessment, and review,

b) documentation of programs and designs, and

c) project management and regulation.

Effective management during construction depends on adequate supervision by the proponent and surveillance by the regulatory authority to ensure implementation of plans. Supervisors and surveillance personnel, in turn, depend on suitable documentation of requirements to be met by the proponent or contractor. Finally, requirements or conditions imposed should reflect agreements reached between the proponent and regulatory authority on the extent and nature of possible impacts and most reasonable means of dealing with them. There is, therefore, a strong link between all phases of the management process. An effective and efficient management program must be designed as a whole with all components mutually supportive. Success or failure of the program can be anticipated prior to construction by examining the adequacy of each of these components.

Planning, Assessment, and Review

The provincial Stage II impact assessment prepared by the proponent traditionally summarizes environmental plans and serves as a basis for design review by government agencies. While some baseline information is still required, the exhaustive bio-physical inventories of the past are no longer necessary. Experience has shown that dollars are better spent on implementation of a flexible environmental program capable of responding to site-specific concerns than on collection of data never used. In order to develop an effective environmental management program, the assessment document should also identify the limitations of mitigative procedures and design. It then contributes to discussion of monitoring and compensation during the review phase.

Public and governmental review of the impact assessment and mitigation plans provides a full opportunity to examine the scope and adequacy of the proponent's environmental program. This is the phase during which a final consensus should be developed on procedures, designs, and, perhaps most importantly, on management and administrative arrangements. One important product of the review should be a detailed set of general and site-specific conditions to be met by the proponent during construction. To this end, a set of project documents are developed which reflect all undertakings by the proponent and agreements reached with the regulatory authorities. This linkage between the planning and construction phases is frequently overlooked in EIA work.

Project Documentation

A number of technical documents are required by field staff during project construction. Without proper documentation there can be no clear understanding of requirements, no determination of compliance, and no enforcement. Documents must be produced, reviewed, and approved prior to construction. The following have been found to be useful on some projects and to be essential on others.

Environmental Procedures Manual

The environmental procedures manual (EPM) can serve as a basis for the proponent's environmental management program. The EPM outlines broad corporate policies as well as staff responsibilities, authority, reporting procedures, and liaison arrangements. It describes briefing and training programs, contingency plans, and procedures for field design changes. This document should cover all aspects of on-site environmental management during construction.

The EPM provides an outline of standard procedures for prevention or mitigation of impacts during construction. It is not site specific and need not be project specific. The purpose of the manual is to familiarize field staff with environmental concerns and the obligations the company has assumed for mitigation and management. Review and approval by provincial ministries constitutes agreement on all construction and administrative procedures discussed within.

The procedures described in the EPM should incorporate normal environmental practices and be compatible with standards applied to other construction projects in the province. The manual can be used as a guide for site-specific environmental design of diversion ditches, culvert placements, access road location, and erosion control measures on slopes and stream banks. While the contractor is required to comply with the procedures described, the manual can provide flexibility by serving as a basis for discussion of site-specific measures with inspection and surveillance personnel.

The EPM should summarize all relevant regulatory requirements which apply to the project. These include federal and provincial legislation, regulations, and guidelines containing environmental stipulations applicable to design, construction, and operation. It should also include a list of federal and provincial government agencies, the legislation administered by them, and the departments from whom approvals are obtained. Addresses and phone numbers of contacts in case of environmental emergency can also be listed.

Alignment Sheets

The engineering alignment sheets are detailed air-photo mosaics which provide specific instructions to the contractor regarding procedures, designs, or construction timing. Site-specific environmental commitments made by the proponent are annotated on these sheets only if they direct the engineer or contractor to perform certain activities in a specific manner. Additional information detailing environmental sensitivities and the rationale for special procedures is not required.

Environmental Index Summary

The environmental index is a written statement of all commitments undertaken by the proponent during planning and review. The equivalent document for pipeline construction is the line list which summarizes all environmentally related agreements made with government agencies and landowners affected by the project. The summary identifies general procedures agreed to by the proponent but also special actions for specific places at certain dates and times. It is usually compiled on a kilometre by kilometre basis and serves as a companion document to the alignment sheets. The summary is continually updated from the hearings phase of design review, if these are held, through pre-construction meetings with the contractor, regulatory agencies and landowners.

Contract Specifications

The contract specifications is the most important document for implementing the environmental management program. It is universally recognized now that environmental planning and design are meaningless unless construction crews comply with standards established. Therefore, the responsibility of the contractor must be articulated clearly and comprehensively so that there can be no misunderstanding of specific procedural requirements or the level of quality desired overall. Environmentally related specifications need not be separated from those governing particular construction activities. Rather, they should be incorporated into those specifications to better indicate the level of performance expected. In this manner, they become the responsibility of the activity inspector and are enforced as part of his quality control function. The better the contractor's understanding of these standards, the better his appreciation of the projects' environmental protection objectives. Knowing the capabilities and limitations of his crew, he can better plan his activities to meet those objectives.

Development of reasonable environmental specifications reduces uncertainty and ultimately leads to more realistic bids for construction contracts. Detailed specifications also reduce disputes in the field regarding payment for unspecified "extra" work ordered. Thus, they are a critical component for efficiency in any environmental management program.

Project Management and Regulation

Surveillance by regulatory agencies may vary from full-time assignment of individuals to the project to only periodic spot checks by regular field staff. The environmental risk associated with the project, work load of field staff, and quality of the proponent's environmental program determine the extent of surveillance activities. If the proponent assumes responsibility for effective implementation of a well designed program, surveillance personnel may only be required for occasional consultation, advisement, and liaison. If the proponent abdicates responsibility or has an ineffective program, surveillance personnel must be in a position to exercise authority and assume more control of construction activities.

Continuity must be maintained throughout the environmental management process. Ideally, the proponent's environmental supervisor should be involved in project planning, design, and review. He then has knowledge of the environmental concerns which led to development of specific requirements for the contractor. Thus, he is better able to explain those requirements where necessary and provide flexibility for design or procedural changes in the field. Early involvement also allows for informal contacts to be made with surveillance personnel facilitating communication later during construction.

The environmental supervisor usually holds a staff position and reports directly to the project engineer or manager in the field. If activity inspectors have frontline responsibility for compliance with specifications, then the environmental supervisor takes on a quality assurance role. He monitors the work of the inspectors and acts as a resource and planning person on the site.

Construction management is facilitated with the formation of a project steering committee. Membership includes a cross section of government and proponent staff involved in day-to-day technical and policy issues associated with project construction. Inclusion of regional resource management personnel provides familiarity with local environmental issues and public concerns. Proponent representation ensures that construction requirements are fully considered when environmental decisions are made. Both the government surveillance officer and the proponent's environmental supervisor should attend steering committee meetings and act as an extension of this body in the field.

Project Evaluations - Summary and Conclusions

The projects evaluated in this study serve to indicate both tangible and intangible factors which contribute to successful environmental management. Goodwill and good intentions are perhaps the best guarantee of success yet the least consistently manageable. The personalities of key players can also contribute significantly to success or failure. For most projects, adequate authority for surveillance and supervisory personnel is critical. In all cases, project management and regulation is facilitated if programs are structured and implemented taking into account the following considerations.

Planning

Review of the 12 projects indicates that planning for environmental management from project inception to completion was usually carried out on a discontinuous basis. There was seldom an overall plan linking inventory and assessment with construction and operation. Most projects evolved as they proceeded with changes in focus as different concerns emerged. The success of the environmental management program generally reflected the degree of planning effort.

The Coquihalla highway was the most successful project evaluated from a planning perspective. Planning was carried out with a high level of cooperation between Ministry of Transportation and Highways (MTH) engineers, federal and provincial agencies, the public, and the contractor. There was adequate time for comprehensive design and development of consensus on design and procedures. The most recent projects, Kelly Lake-Nicola transmission line and Quinsam Coal, followed a more formal and comprehensive planning process and were also successful.

Planning of the Alaska Highway Gas Pipeline (AHGP) prebuild and, to a lesser extent, the Coquihalla pipeline was marked by a lack of coordination between proponent and government. As a result, effective environmental management systems were not put in place, disputes arose during construction, and relations were unnecessarily damaged. Poor relations between proponent and government discourages joint planning and can result in more stringent regulatory requirements with less flexibility and negotiation on future projects.

Assessment

Environmental assessment of the 12 projects was carried out under a variety of regulatory processes. These include the B.C. Energy Project Review process, the B.C. Guidelines for Linear Development, and the National Energy Board review process. As part of the environmental management process, assessment must be directed toward development of mitigative measures for use during construction and operation. The emphasis of this review, therefore, was on examining the adequacy of the assessment phase in identifying potential impacts and producing specific measures for impact mitigation..

For many of the earlier projects evaluated, there was only a loose connection between impact assessment work and construction planning. On the Coquihalla pipeline, the required studies were carried out but, beyond establishing timing windows, the information gathered was not completely incorporated into plans and designs. The disputes between some regulatory personnel and Westcoast Transmission were largely due to a lack of understanding and agreement on fish and stream sensitivities. There was also no agreement on the effectiveness of mitigation measures. These should have been addressed more extensively in the assessment. Assessments for the AHGP prebuild and Tumbler Ridge Railway line were intended more for permit and approval acquisition than as a prerequisite for planning and design.

Assessment information for the Coquihalla highway, Quinsam Coal, and CNR twin tracking projects was utilized quite effectively. In the case of Quinsam Coal, assessment led directly to development of the monitoring program. With the CNR, assessment was an ongoing process integrated with planning, design, and review.

Review

Design review must ensure adequacy of the information collected and the programs developed. Regardless of the extent and sophistication of these programs or the institutional arrangements for management and regulation, regulatory and public review should result in consensus between the proponent and government agencies. All aspects affecting management and administration should be agreed upon and specified in the construction documentation prior to issuance of permits and approvals.

Those projects where design review appears to have been most successful are the Kelly Lake-Nicola transmission line, Quinsam Coal, and CNR twin tracking. In each case, administrative structures were in place which allowed for review of plans and discussion of programs on an ongoing basis. Rather than being a single event in a linear process, review was more completely integrated into an adaptive management system.

Review of Tumbler Ridge Railway line plans was a formality in many respects. No agreements on project management were made, no conditions were attached to the approval, and construction was allowed to proceed long before permits were issued. On the AHGP prebuild, federal and provincial agencies were primarily concerned with their own plans and procedures rather than reviewing the company's. As a result, project documents and plans had several inconsistencies which reduced the effectiveness of the environmental program. For the Revelstoke dam, emphasis was placed on monitoring during the review phase but no system was developed subsequently to follow the process through in any adaptive manner. Environmental monitoring programs were established but had no mechanism for feedback into planning or construction.

Documentation

All documentation required of the proponent must have a practical purpose during construction. The proponent should be given sufficient freedom to develop documents and incorporate them into the environmental program according to specific needs. It is in his interest to produce contract documents which provide sufficient guidance and authority to ensure compliance with environmental requirements by the contractor.

B.C. Hydro recognized the importance of good documentation during construction. The company improved access plans from the Tumbler Ridge project to Kelly Lake-Nicola and then Cranbrook-Alberta border. It continued to refine its procedures manual, index maps, and summaries. Similarly, MTH found deficiencies in its construction specifications for the North Island highway and subsequently revised them for the Tumbler Ridge and Coquihalla projects.

The AHGP prebuild demonstrated the necessity of good documentation for effective supervision and surveillance. Although all required documents were produced, they were intended for securing approval and were of little use for company personnel during construction. The Northern Pipeline Agency (NPA) Terms and Conditions was the primary document for surveillance personnel but it too was impractical for use in the field. With no clear statement of specific conditions or requirements, compliance could not be determined or enforced.

Effective, efficient, and consistent implementation of programs by government and proponent requires some integration of regulatory and management systems. Three of the projects reviewed had a formal steering committee or joint task force: Kelly Lake-Nicola transmission line, CNR twin tracking, and Quinsam Coal. In each case these bodies provided a strong linkage between design review and construction. For Kelly Lake-Nicola and the CNR project, construction was characterized by close adherence to approved procedures, good relations between parties, flexibility in handling design changes, and responsive management overall. A principal conclusion of this study, therefore, is that a formally designated administrative body can greatly assist in project environmental management. In order for it to function most effectively, the following factors are necessary.

Statements of Policy and Objectives

The proponent, the contractor, and the regulatory authority must have a clear and mutual understanding of the objectives of the environmental management program. Government policy must be articulated in legislation or presented in orders applying to specific projects. Company policy and objectives must also be stated clearly and can be set out for the government and contractor in the procedures manual.

Kelly Lake-Nicola and Quinsam Coal are the best examples of projects where government policy was clearly articulated. In the former case, orders were issued under the B.C. Utilities Commission Act. B.C. Hydro responded with a comprehensive statement of intent for its environmental management program. This was included in the procedures manual developed for the project. The province specified requirements for Quinsam Coal in its Stage II approval-in-principle. The company assumed as undertakings the conditions from the public inquiry and also stated policy and objectives in its procedures manual.

Kelly Lake-Nicola demonstrated that project management is facilitated when there are no surprise requirements or procedures. The AHGP prebuild experience indicated that statements of policy and objectives are meaningless unless there is a system in place for implementation and the necessary will to see it through. In this respect, statements of policy and objectives are a means to evaluate the proponent's progress in developing an environmental program or to assess the emphasis the government and proponent are placing on environmental matters.

Terms of Reference

The responsibilities of the project steering committee, surveillance officer, and environmental supervisor must be clearly established and acceptable to regulatory authorities and the proponent. All parties in the field must be aware of the roles and authority of these positions. Terms of reference for the environmental supervisor are contained in the procedures manual. Terms for the steering committee and surveillance officer are set out in the regulations, permits, or orders.

Projects for which environmental supervisors had comprehensive terms of reference include Tumbler Ridge transmission line, Kelly Lake-Nicola transmission line, Cranbrook-Alberta Border transmission line, and CNR twin tracking. The roles, responsibilities, and authority of the supervisor were well understood on each job site and the individuals worked effectively within the system. The AHGP prebuild and Revelstoke dam are similar in that terms of reference were produced but never reflected the actual role of the supervisors. The individuals were relatively ineffective in the field as far as controlling the contractor's activities.

The AHGP prebuild was the only project with full-time surveillance. Although the NPA surveillance officers and the provincial field coordinator had adequate terms of reference, other aspects of the program did not allow them to fully carry out the stated responsibilities. Comprehensive terms of reference are important for surveillance and supervision if the environmental management program is in place. They cannot substitute for that program, however.

Authority

Effective implementation of the environmental management program requires adequate authority for the project steering committee, surveillance officer, and environmental supervisor. The steering committee needs sufficient authority to direct the actions of the surveillance officer in the field and to amend permits and licenses as required. Authority for the steering committee can be established by order under such legislation as the B.C. Utilities Commission Act.

The surveillance officer must have adequate authority to enforce compliance with regulations and permit conditions. If the project is of sufficient size or environmental risk to warrant full-time surveillance, the individual must be able to control events quickly without having to call for additional support. This authority generally stems from such legislation as the Canada Fisheries Act or B.C. Water Act, although the B.C. Environmental Management Act and B.C. Utilities Commission Act could also be used. Additional authority may be vested in the surveillance officer through federal provincial agreements or legislation developed for specific projects.

Adequate authority must be vested in the environmental supervisor to ensure compliance by the contractor with specifications and other requirements in the project documents. Emergency power for stopping work at individual sites is necessary if the contractor's actions are unacceptable. The supervisor's authority is established by company policy as expressed in the terms of reference and job description for the position which are included in the procedures manual.

The only projects for which environmental supervisors lacked adequate authority were the AHGP prebuild and Revelstoke dam. In both cases, the terms of reference for the position indicated responsibility for ensuring compliance by the contractor with the environmental requirements. In both cases, actual authority was not transferred from management to the environmental supervisors.

On the AHGP prebuild and, to a lesser extent, the Tumbler Ridge railway line, the authority of surveillance personnel was clearly inadequate. Problems were reported on other projects with non-compliance, but most individuals felt that they had adequate authority under existing legislation and regulations. This is likely the case where there is effective supervision, good relations between supervisor and surveillance personnel, and sufficient political will for enforcement. The CNR project is a good example of this. However, on other projects, such as the Tumbler Ridge and North Island highways, agency field staff could not respond quickly and effectively to clear-cut cases of non-compliance. Consistent compliance cannot be guaranteed if other surveillance personnel must rely on a Conservation Officer or Fisheries Officer for enforcement.

Legislative authority for environmental management of Kelly Lake-Nicola was delegated by Ministerial Order under the B.C. Utilities Commission Act to the project steering committee. With this authority, the committee was able to require all documents and programs from B.C. Hydro which were felt to be necessary for proper environmental management. The steering committee provided a regular forum for discussion of all construction issues. Agency personnel were not simply restricted to enforcing permit conditions.

Reporting and Liaison

Administrative arrangements must be made for communication between all parties during construction. Formal and informal lines of communication must be defined between the contractor, engineer, environmental supervisor, and surveillance personnel. Weekly written reports by the environmental supervisor, where applicable, should be circulated to the project engineer, project manager, company environmental manager, and the regulatory authorities. Reporting arrangements, including scope and depth, should be specified in the procedures manual.

It is important for project management that the proponent establish and maintain a responsive working relationship with government and the public.

Effective liaison has its roots in informal arrangements developed during planning, assessment, and review, when key personnel seek out counterparts and establish those relationships. Regular steering committee meetings provide the best forum for private individuals, interest groups, the proponent, and government personnel to discuss relevant issues. The process is aided by a comprehensive reporting system.

The short planning, assessment, and review phase for the Tumbler Ridge railway project and the late appointment of the environmental engineer did not facilitate development of relations with government agencies. Regional Ministry of Environment (MOE) personnel indicated they had little or no confidence in the reports prepared by this individual. Repeated errors and omissions contributed to distrust and poor relations between government and the company. On the AHGP prebuild, the company did not have an environmental department aside from its consultant to liaise with regulatory personnel. Both projects proceeded without working relationships between individuals and environmental management suffered as a result.

These projects contrast with the Tumbler Ridge transmission line and CNR twin tracking. Both projects were characterized by comprehensive reporting and generally harmonious relations between the environmental supervisor and regulatory personnel. The reports served to keep management informed of project developments and assisted them in monitoring the effectiveness of the environmental management arrangements. They also served as a valuable "running record" of plans and agreements made between the supervisor and surveillance personnel regarding site-specific concerns. Relationships were established on a formal basis for Kelly Lake-Nicola with the formation of the provincial steering committee. The system proved very effective for resolving problems once the members understood the roles and positions of the others.

Inter-governmental Agreement

Projects with overlapping jurisdiction of federal and provincial governments require specific agreements on environmental management. These agreements must clearly delegate responsibility for various aspects of management and administration. All major components of the agreement should be in place well before final approvals are granted and construction is under way.

Many of the problems experienced with the AHGP prebuild can be attributed to the lack of formal inter-governmental agreement. Considerable time and energy during the planning phase went into drafting such an agreement but it was never signed and adopted. As a result, more time and energy during construction went into attempts to resolve jurisdictional disputes.

These problems were avoided on the CNR project as the Environmental Assessment Panel was able to establish a joint review system which effectively addressed provincial concerns. Twin tracking also differed from the prebuild in that a surveillance system was not imposed on the project with federal personnel assuming responsibility for traditionally provincial environmental concerns. CNR was able to plan and acquire approvals and permits within a single regulatory framework.

Recommendations

To be most effective, environmental management must be considered as an integral part of project planning and construction. All components of the environmental program must be linked together and function in harmony with design and construction arrangements. Management goals and objectives must be developed early and be clearly articulated. The following recommendations are intended to identify steps necessary to move toward more consistently effective project environmental management in British Columbia.

1) The province should formalize more specific regulatory arrangements for complete environmental management of construction projects. Changes in development guidelines procedures and their application should be studied which will more closely align project environmental assessment and design review with management during construction. The roles and responsibilities of provincial agencies involved in project regulation should be revised and coordinated as necessary for more effective contribution within the management process.
2) Major proponents should be required to develop environmental management programs which are integrated into their project proposal and hence into the regulatory system. Specific, practical requirements for the proponent should be set out which reflect stated provincial objectives regarding program

design. Much more interaction is necessary between the proponent and government agencies at the beginning of the planning phase to design assessment studies and establish the basis for monitoring, surveillance, and supervision programs.

3) All environmental program components described in this study should be systematically incorporated into the management process. The province should exercise authority under existing legislation to ensure that planning, assessment, and review are directed toward more flexible, adaptive management during construction. Documentation should be standardized to the extent that all projects require similar documents but proponents are given sufficient freedom to modify them according to their particular needs. Both the proponent and government should articulate statements of policy and objectives for project environmental management. Surveillance and supervisory personnel should have comprehensive terms of reference, adequate authority, and well defined reporting arrangements. Further study should be given to development of inter-governmental agreements for joint project management.

4) The province should continue to develop an environmental management process by applying it to selected projects on an experimental basis. This can be done using existing staff and within the framework of current regulatory procedures. Emphasis should be put on developing more adaptive management strategies. To do this, expenditures by the proponent should be shifted from initial impact assessment to more extensive management during and after construction. Bio-physical monitoring and environmental quality assurance programs, where possible, should provide information for modification of activities within the span of construction. Procedures such as fluming of stream crossings, which arise as contentious issues on many projects, should be monitored and evaluated in terms of efficiency and effectiveness. The environmental management program as a whole should have an internal audit system to evaluate its effectiveness on an ongoing basis. If goals and objectives are clearly stated, a project steering committee can partially perform this function. Acceptance of these conditions and incorporation into the proponent's environmental management program should be a requirement for project approval.

5) The environmental programs of all projects, whether managed under new or existing arrangements, should be routinely evaluated after completion. Reporting and audit information should be collected and analyzed to determine the strengths and weaknesses of the environmental management system. Wherever possible, a report should be produced jointly by the proponent and regulatory agencies assessing all aspects of project management and making recommendations for improvement. Project steering committees, where appointed, are the logical bodies to undertake this review.

THE VENTURE GAS DEVELOPMENT: AN EVALUATION OF MANAGEMENT PROCEDURES

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Introduction

In 1979, commercial quantities of natural gas and liquids were found in the vicinity of Sable Island on the Scotia Shelf off the Atlantic Coast of Canada (Figure 1). A proposed project for export of 400 mcfd (10.2 x 10^6 m^3/d) of gas (Mobil Oil Ltd., 1983) was referred to the Federal Environmental Assessment and Review Office in September, 1982 by the federal initiating agency, the Canada Oil and Gas Lands Administration. A joint federal/provincial panel was convened and public review held in the autumn of 1983. The Sable Island Environmental Assessment Panel provided its report to the federal and provincial Ministers of the Environment in December of 1983 (Federal Environmental Assessment Review Office, 1983).

The Panel's report contained thirty-eight recommendations related to the effects of the development on the environment and the effects of the environment on the development. Perhaps, because of the conceptual nature of the Impact Statement, many of the recommendations were related to planning and design. Collection of further information on physical and biological conditions in the area affected, contingency planning for industrial and environmental emergencies and monitoring, were repeated factors in the recommendations.

Two of the recommendations particularly bear on follow-up. As an overall condition to proceeding with the project, the Panel recommended that "comprehensive contingency plans and monitoring programs" should be prepared and implemented. Second, the Panel recommended that an annual federal/provincial environmental audit be jointly conducted by the Ministers of the Environment to follow implementation of the report's recommendations and any commitments made by the proponent.

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* These remarks represent the personal opinion of the author and do not necessarily reflect the policy of Environment Canada.

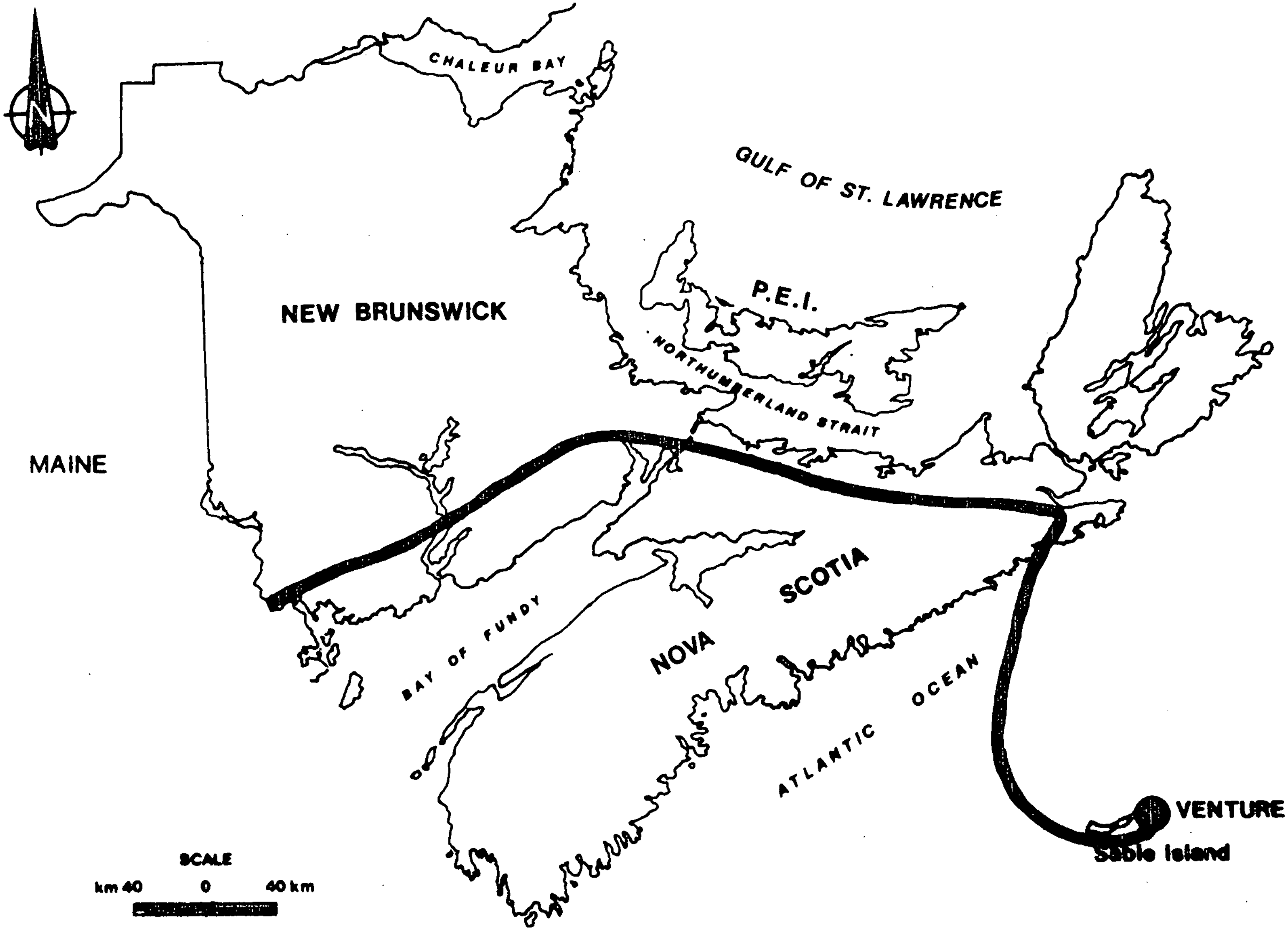


FIGURE 1 VENTURE FIELD GENERALIZED ROUTE OF THE MARINE AND EXPORT PIPELINES

These points will be the focus of further discussion in this paper. Some background on the management structure within which follow-up to the Venture Gas Development must take place will provide context for the analysis.

Background to the Study

The Environmental Management Structure

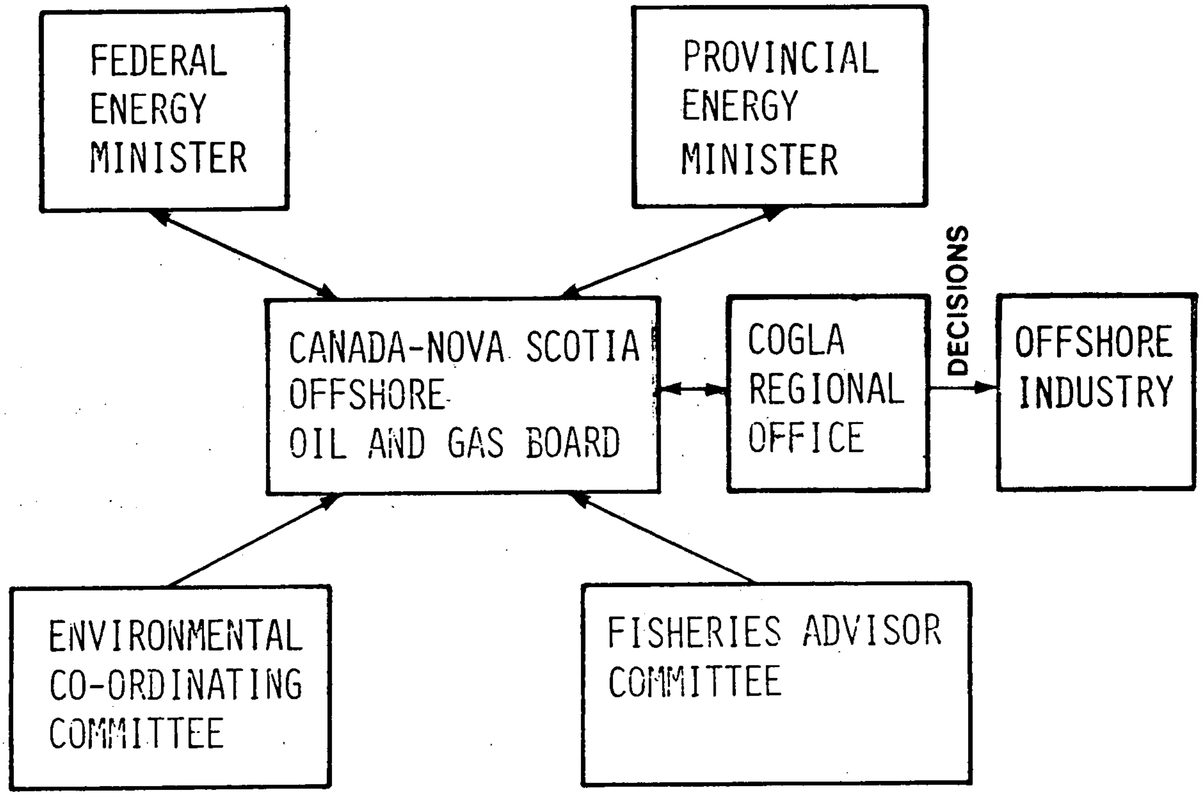
The management and regulatory regime for oil and gas development on the Scotian Shelf and Canadian Georges Bank is framed by the federal/provincial agreement of March, 1982.

Overall management decisions for day-to-day operations are vested in the federal/provincial Joint Management Board (Figure 2). The Board is supported by a regional office of the Canada Oil and Gas Lands Administration (COGLA). COGLA relies on its federal acts for mandate to regulate offshore exploration and development and receives advice on the environmental implications of its activities and those of industry from Environment Canada and other agencies.

COGLA (1982) follows a staged approach to regulation of a project (Figure 3). Under the Federal Environmental Assessment and Review Process, Environment Canada is indirectly involved through interdepartmental committees and, in the case of the Scotian Shelf and Georges Bank, through the Environmental Coordinating Committee. This follows the "self-assessment" philosophy of the Order-in-Council.

The Environmental Co-ordinating Committee advises on the environmental consequences of activities at each approval stage and COGLA can identify environmental stipulations as part of the approval process.

The National Energy Board holds jurisdiction over any project which exports energy, transports it across provincial boundaries or on Canada Lands. For this development, the Board regulates the export license, the export pipeline and, subject to decisions yet to be announced, the submarine pipeline from the gas field to the processing facility onshore. As with COGLA, the Board is also charged with environmental protection under its mandate. It attempts to fulfill this requirement by requiring an environmental action plan as part of the approvals application and proof of completion of the plan once the facilities are constructed but before the operating license is issued.



COGLA - CO-CHAIRMAN
NSDOE - CO-CHAIRMAN
EC
DFO
NSDOE
NSME
CCG
NS FISH

FIGURE 2 SCOTIAN SHELF FEDERAL/PROVINCIAL OFFSHORE PETROLEUM JOINT MANAGEMENT STRUCTURE

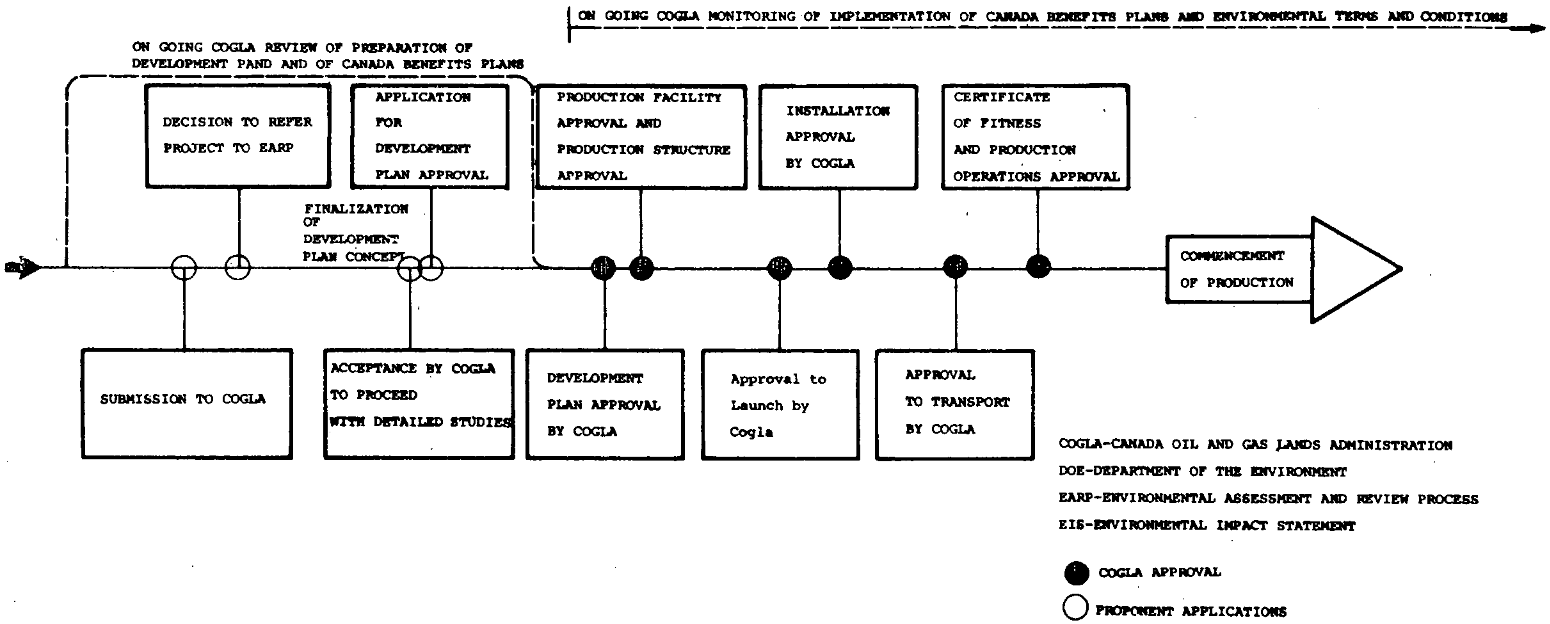


FIGURE 3 TYPICAL COGLA APPROVALS PROCESS FOR A FIXED HYDROCARBON SYSTEM*

* This chart describes COGLA's role in the approvals process and does not include regulatory approvals granted by other agencies. The chart is based on draft regulations to be promulgated under the <u>Oil and Gas Production and Conservation Act</u>. Proportions do not reflect time frames?

Other federal and provincial agencies have mandates specific to particular facets of a project.

The Follow-up Mechanism

There are two main guideposts by which follow-up to the Venture Project has been developed. The Sable Island Environmental Assessment Panel (1983) recommended that the federal and provincial Departments of Environment should monitor the implementation of its recommendations and provide an annual report to their ministers for public distribution. As well, in June 1984, the Government of Canada passed an Order-in-Council on the Environmental Assessment and Review Process. Among other things, this Order states that it is the responsibility of the initiating department to decide the extent to which the recommendation of a review panel should become a requirement of the Government of Canada prior to authorizing the commencement of a proposal. As shown in Figure 3, the Canada Oil and Gas Lands Administration recognizes this ongoing role as part of its staged approach to project approvals.

In addition to the above mechanisms, which are directed specifically toward Environmental Assessment Panel recommendations, federal and provincial departments having various environmental protection mandates will exercise these, most likely in co-operation with the "lead" regulatory agencies. For example, the Federal Department of Fisheries and Oceans is responsible under the Fisheries Act to ensure that fish habitat is not disrupted. Therefore, the agency will work closely with the National Energy Board in ensuring that pipeline stream crossings are done in a way that will minimize habitat damage.

The Venture Follow-up

Due to difficulties in defining the gas reservoirs and an underground blowout at one of the delineation wells, the Venture Development has been delayed by approximately two years. Nevertheless, some of the groundwork has been laid for follow-up to the Assessment Panel's recommendations.

The Initiator's Role

All the time of writing, COGLA has yet to formally respond to the Environmental Assessment Panel's Report. They have, however, taken steps to address some of the recommendations. Shortly after release of the Panel Report, COGLA held a meeting between the project proponents and members of the Environmental Co-ordinating Committee. The implications of the recommendations were discussed and the proponent made commitments to meet some of the more technical stipulations. However, certain recommendations have yet to be acted upon; for example, collection of baseline data and monitoring programs. Because there has been no formal response to Panel recommendations, the extent to which COGLA plans to act on these is uncertain.

The Environment Canada Role

Immediately upon receipt of the Panel Report, Environment Canada commenced an analysis of the recommendations. This is in accordance with departmental policy (Environment Canada, 1980). An implementation strategy (Figure 4) was prepared and has formed the basis for agency actions to date.

Environment Canada is directly responsible for only those recommendations for which it has a direct mandate. Under the Government Organization Act of 1979, the Department is responsible for, among other matters, "all matters over which the Parliament of Canada has jurisdiction, not by law assigned to any other department, board or agency of the Government of Canada...". Otherwise, it acts as an advisor to the federal/provincial management board and its secretariat, the Canada Oil and Gas Lands Administration.

Follow-up activities to date have been limited to reviewing a preliminary Development Plan and several supplementary reports on such technical matters as environmental design criteria. No substantial progress has been made on any of the environmental protection measures.

Preliminary discussions have been held with the province of Nova Scotia on implementation of an environmental audit. These have not progressed, however, because the province is presently undertaking a review of its federal/provincial offshore management agreement in light of the recently concluded Atlantic Accord.

Other Options for Follow-up

Environment Canada continues to argue for the implementation of the majority of the panel recommendations, through the Environmental Co-ordinating Committee and through other links with COGLA. Discussions have been held with

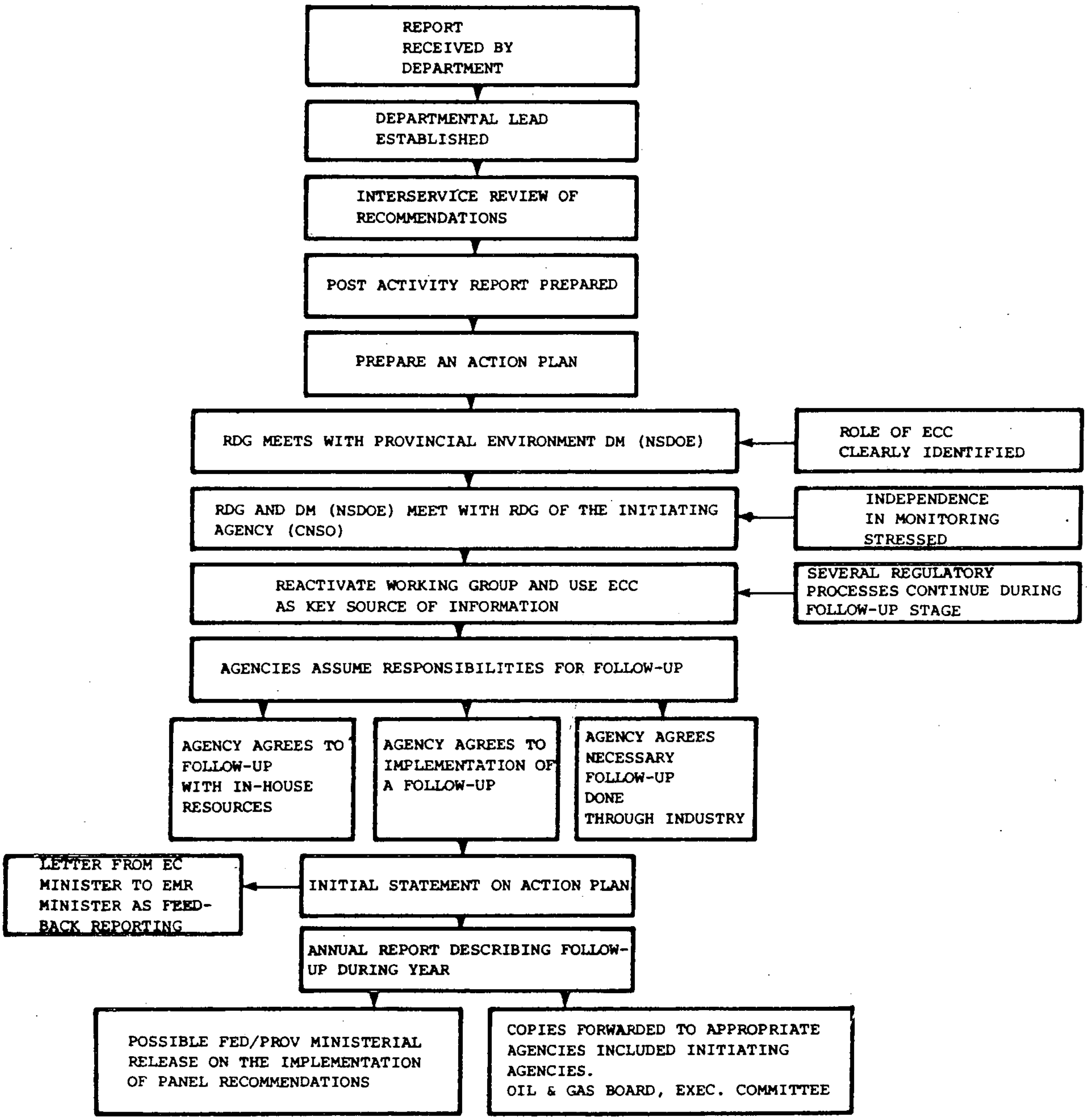


FIGURE 4 FOLLOW-UP FOR THE ENVIRONMENTAL ASSESSMENT PANEL RECOMMENDATIONS FOR THE VENTURE GAS DEVELOPMENT PROJECT

the National Energy Board on the need for formal intervention during Facilities Hearings and on the question of the Board's jurisdiction over the marine pipeline. As soon as the province has completed their review of the joint - management agreement, discussions will be re-opened on a joint environmental audit.

Analysis of Follow-up Management

For petroleum developments on Canada Lands, the Federal Environmental Assessment and Review Process, to date, has taken the role of the first stage of an ongoing process of environmental assessment and management (Figure 3). This is an acceptable and, I would argue, an ideal stage for a mechanism that can provide a set of environmental planning principles by which a development can be designed, constructed and operated (Beanlands and Duinker, 1983). However, as Environment Canada (1983, 1985) has stated in its submissions to the Sable Island Environmental Assessment Panel and to the Hibernia Oil Development Environmental Assessment Panel, this approach can only be acceptable if there is an effective means of implementing environmental standards.

Environmental management, after Holling (1978), means that environmental matters become an integral part of project planning and implementation, from initial conception through to abandonment. Just as planners identify material specifications and engineering design constraints, environmental specifications and constraints are incorporated into all facets of the development. Such an approach requires considerable expertise on the part of both the project designers and engineers and their environmental advisors. The key to success of such an approach is a common goal and mutual respect among all participants.

Incorporation of environmental management into the staged approval process should be an effective means for environmental protection. However, since none of the offshore developments have proceeded to the stage of implementation of environmental protection measures, it remains to be seen whether this will in fact be the case. Much depends on the resolve of the main regulatory agency, the Canada Oil and Gas Lands Administration. Experience with the Canada-Nova Scotia Environmental Co-ordinating Committee has not been fully satisfactory, to date. This may be a problem of growing pains. There is a need to clarify responsibilities, reporting and decision review procedures. As well, difficulties have been experienced with the exchange of technical expertise and advice between government and industry.

The provincial review of the offshore management agreement may result in changes in the co-ordinating committee. Environment Canada will continue to use the existing mechanisms until it is proven that they are ineffective for environmental protection.

Effectiveness also requires credibility of all participants, the sort that fosters mutual respect. Credibility on the part of advisors, such as Environment Canada, requires a high level of expertise, not only in strictly environmental matters, but also in areas relating to the projects being managed. Such expertise is costly to acquire and maintain but is a cost of doing business if we are serious about environmental quality. If applied early and continuously, it is arguably far less expensive than retrofitting or clean-up of environmental damage.

Areas of Improvement

It is difficult to discuss improvements in a process which has yet to be fully tested. However, based on our experience to date, some suggestions for improvement are offered.

1) The means for development and communication of environmental advice from expert to end user should contain as few links as possible.

Very often the scientific basis and reasoning for a particular recommendation can be lost if there are sufficient filters between the environmental scientist or engineer and the manager or project designer. Such steps can defeat the intent of environmental protection. Obviously, it is not useful for policymakers to have to deal with highly technical questions. A forum should be provided to give technical environmental input directly to the project designers. It both simplifies and speeds regulation if policy and technical matters are clearly defined and obviously separated.

2) There should be a clear and effective means to ensure that environmental protection measures are effectively implemented.

There are several ways to meet this objective, apart from environmental audit by the federal and provincial Department's of the Environment, as was recommended by the Sable Island Environmental Assessment Panel. Environmental contracts, performance bonding and environmental protection clauses between regulators and proponents or general and sub-contractors have all been effective in ensuring that environmental protection measures are implemented. Of course, punitive measures are also available, but only as a last resort, and often after the fact. They are not the most effective means of obtaining environmental protection.

3) There should be a clear government policy on follow-up to environmental impact assessment.

Such a policy should not only state that follow-up will be done; it should also specify the major components. These could include, for example, auditing the implementation of panel recommendations, validation of impact predictions, or mitigation when predictions of no effect are shown to be incorrect. A clear means of ensuring effective implementation of the policy by both government agencies and private proponents should be identified. Some form of environmental audit is an obvious candidate.

4) Agencies such as Environment Canada which have significant environmental protection roles should identify sufficient resources to ensure that any government follow-up policy can be effectively implemented.

The people and money required for such a role need not be large when compared to the development budget of a single gas field in the Venture project. Following the "user pays" principle, the major government resource requirement becomes one of knowledge; knowledge of the potential for environmental damage, of the best available mitigation or treatment technology, of the means to predict and detect change, and an ability to communicate with project designers and engineers. Assurance of implementation of protection measures can be achieved through use of existing inspectorates and periodic environmental audit. The key here is to show developers that ongoing management will reduce the cost of environmental protection, not increase it.

Some lessons have been learned from the impact assessment of the Venture development. These are being used in the current environmental review of Hibernia offshore oil development. The management structure is again in a state of flux due to the early stage of implementation of the federal/provincial joint management agreement, the so-called Atlantic Accord. It remains too early to see the outcome of negotiations but we continue to argue for direct and effective incorporation of environment factors into all stages of regulation and development.

Conclusion

An ongoing consideration of environmental factors is advocated, from the inception of a project through design, planning and construction to operation and ultimate abandonment. The start of this process is effective impact assessment. The essential ongoing component is follow-up.

The components of an effective follow-up mechanism exist for the Venture Gas project. It is still too early to say whether this will ensure that development will occur in an environmentally acceptable manner. A similar, but slightly different framework, should exist for the Hibernia Oil development and, similarly, work will continue to have an acceptable environmental management framework put in place for the Grand Banks.

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ENVIRONMENTAL APPRAISAL AND AUDITS: A CASE STUDY OF THEIR APPLICATION BY THE BONNEVILLE POWER ADMINISTRATION

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Bonneville Power Administration

Introduction

The Bonneville Power Administration (BPA) has developed a program of regular internal environmental appraisals of its existing and newly constructed projects. BPA is the federal power marketing agency for the Pacific Northwest Region, with a service area covering 300 000 square miles. It's facilities in four states (Figure 1) are subject both to Federal environmental standards and regulations, and in some cases, to those of the local jurisdictions where they are situated. The Environmental Appraisal Program is designed to insure not only that BPA complies with these many ordinances, but also to encourage employee awareness of environmental concerns and potential problems. It is coordinated with the agency's long-standing program for environmental protection and is intended to make that program even more effective.

BPA's Administrator approved the Environmental Appraisal Program on May 30, 1984, and studies began almost immediately. Appraisals of newly constructed projects determine whether or not recommendations resulting from earlier environmental assessments have successfully solved the problems and, if not, how they can be corrected, not only for the project in question, but also for projects in the future. At older facilities, problems that have developed over years of operation are investigated and recommendations are made to bring them into compliance with current standards.

The results of this first year and a half of conducting environmental appraisals have been quite positive. BPA managers, supervisors, and project personnel have participated enthusiastically. Results have included the correction of problems that were encountered, the recognition of many areas with positive effects, and the identification of a number of methods for improving program performance.

This paper presents, in summary form, the goals and objectives of the Environmental Appraisal Program, its scope and components, the processes used on

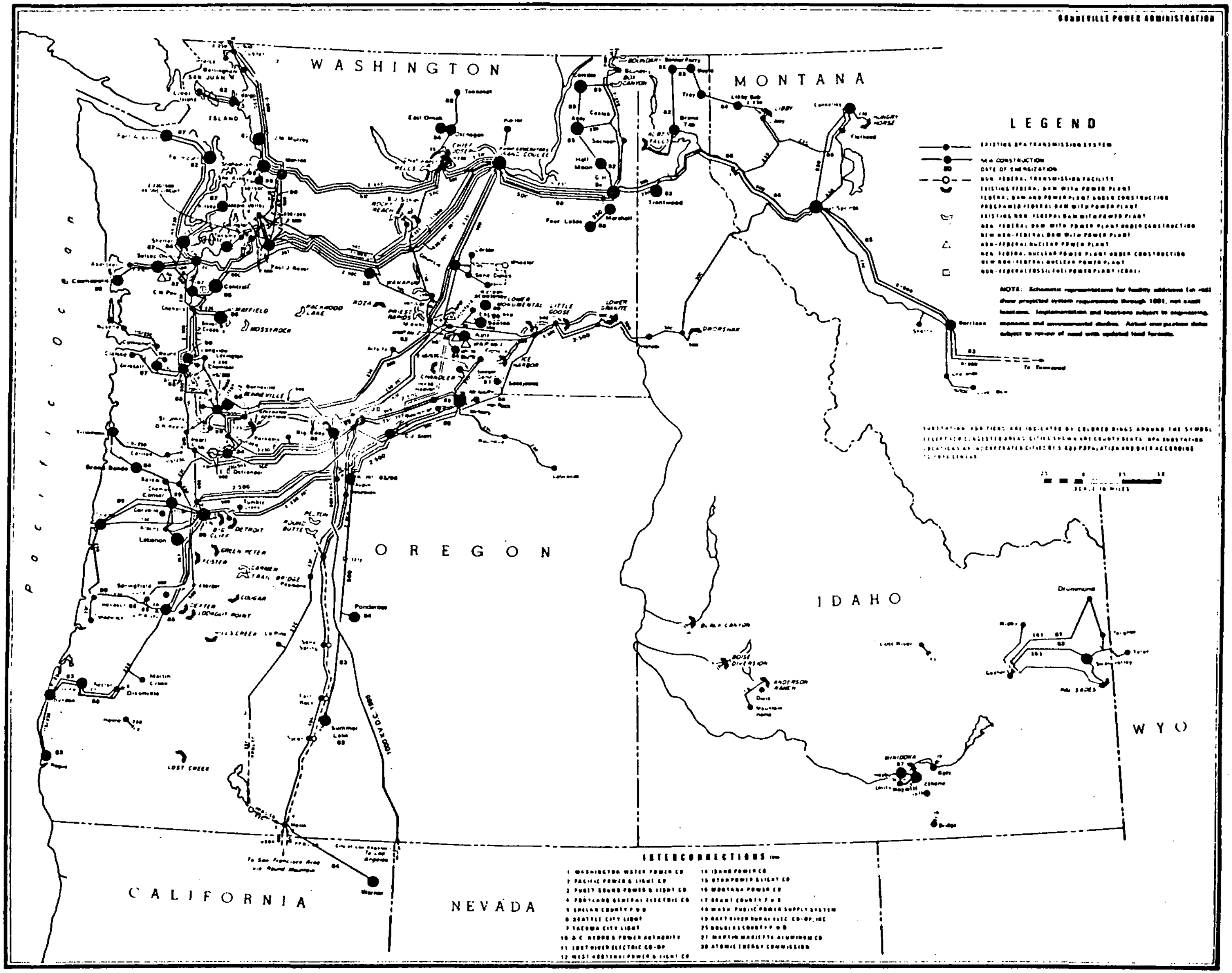


FIGURE 1 BPA TRANSMISSION SYSTEM AND PROJECTED FACILITIES ADDITIONS

existing and newly constructed facilities, and the results of several selected field appraisals and BPA's 1984 Functional Appraisal. The last section describes the direction BPA envisions for future programs.

Overview of BPA's Environmental Appraisal Program

Program Goals and Objectives

Unlike traditional audits, environmental appraisals are a new activity for BPA and are intended to be a positive program that does more than just verify that the requirements of regulations are being met. The program has the following goals and objectives.

Primary Goal

- Assure that BPA's environmental policies and requirements are appropriately interpreted and implemented.

Secondary Goals

- Help line managers, achieve BPA's environmental compliance commitments.
- Increase employees awareness of environmental regulation and BPA's commitment to compliance.
- Provide management with objective, timely, and reliable information on BPA and BPA contractor environmental performance.
- Evaluate the effectiveness and efficiency of BPA's implementation of measures to avoid, minimize, rectify, or reduce adverse impacts to the environment and of measures to compensate for such impacts.
- Provide management with recommendations, where appropriate for improvement of BPA's environmental program performance.
- Develop and recommend long-term solutions to current environmental problems in anticipation of future standards or conditions.
- Evaluate the accuracy of environmental analysis or impact predictions and identify methods for improvement, where necessary.

Components of Environmental Appraisal Program

The BPA Environmental Appraisal Program has four components that involve all levels of personnel from DOE and BPA managers to those who operate and maintain the equipment (Figure 2). The four components are: 1) management appraisal, 2) functional appraisal, 3) field appraisal, and 4) internal audit. Table 1 describes: what each component is, who is responsible for it, when it is performed, and it's scope.

Organization and Staffing

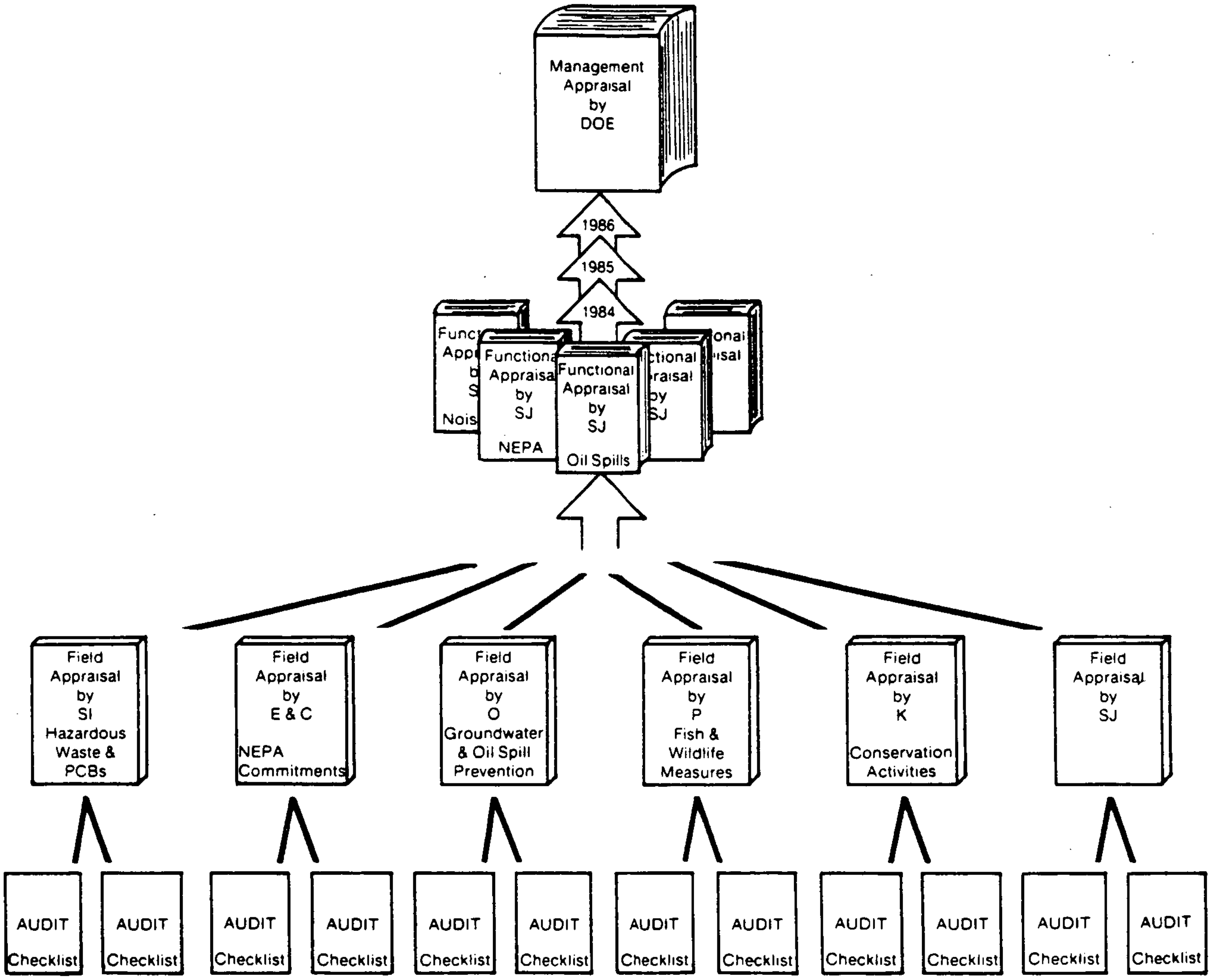
The BPA Environmental Appraisal Program is managed by the Environmental Manager, who insures BPA's implementation of Federal and DOE environmental regulations. The Environmental Manager has a staff of six specialists who are responsible for:

1) co-ordinating management and field appraisals with DOE and BPA Program Offices;
2) assuring that functional appraisals of BPA's activities are conducted with sufficient scope and frequency to insure effectiveness of environmental activities; and
3) co-ordinating preparation of field appraisals on select BPA activities or projects.

The Environmental Manager is assisted in the assessment of BPA program activities by Environmental Coordinators in each of the four program offices: Power Management, Engineering and Construction, Regional Operations, and Conservation.

The BPA appraisal program has initially concentrated on the programs of the Offices of Engineering and Construction (E&C) and Regional Operations (RO). The E&C program is coordinated by the E&C Environmental Coordinator who also serves as the Chief of the Environmental Analysis Branch. He has assigned responsibility for coordination of the program to his Senior Technical Advisor who manages the program. Individual field appraisals are coordinated by five environmental specialists assigned from the Environmental Analysis Branch's Project Analysis Section. E&C appraisal teams have from four to eight members including the engineering project managers, representatives from the involved location, design, construction and maintenance organizations and from the Office of the Environmental Manager.

The Environmental Coordinator from the RO Program Office coordinates the preparation of field appraisals with each of four field offices: Walla Walla, WA;



LEGEND:

SJ	ENVIRONMENTAL MANAGER
SI	SAFETY OFFICE
E&C	OFFICE OF ENGINEERING & CONSTRUCTION
O	OFFICE OF REGIONAL OPERATIONS
P	OFFICE OF POWER & RESOURCES MANAGEMENT
K	OFFICE OF CONSERVATION
DOE	DEPARTMENT OF ENERGY

FIGURE 2 COMPONENTS OF BPA ENVIRONMENTAL APPRAISAL PROGRAM

TABLE 1 COMPONENTS OF BPA ENVIRONMENTAL APPRAISAL PROGRAM

		Management Appraisal	
•	WHAT	=	Review of BPA Appraisal Program
•	WHO	=	By DOE
•	WHEN	=	Once every 3 years (approximately)
•	SCOPE	=	Entire BPA Environmental Program
		Functional Appraisal	
•	WHAT	=	BPA-wide review. Compiles info. from field Appraisals
•	WHO	=	Environmental Managers Office - task team
•	WHEN	=	Annually
•	SCOPE	=	Summary and analysis of field appraisal and internal audit
		Field Appraisal	
•	WHAT	=	On-site review of environmental specialty discipline
•	WHO	=	Environmental Coordinator, Program Manager
•	WHEN	=	Pursuant to an annual schedule
•	SCOPE	=	Based on priorities previously identified
		Internal Audit	
•	WHAT	=	Verifies compliance at specific facilities
•	WHO	=	On-site personnel
•	WHEN	=	Completed as needed
•	SCOPE	=	Specific issues at specific facilities

Seattle, WA; Portland, OR; and Spokane, WA. These appraisals are conducted under the leadership of the Environmental Manager's Office with other team representatives from the involved maintenance, and operations organizations and the RO Environmental Coordinator's Office.

The BPA Environmental Appraisal Committee was also formed to provide a high-level management forum for developing solutions to problems which have been identified, but could not be resolved by the normal appraisal process. The committee is made up of the Deputy Assistant Administrators from each of the program offices and the Environmental Manager.

Appraisal and Audit Frequency

All existing facilities will eventually be audited; four were audited in 1984 and twelve in 1985. Appraisals of newly constructed facilities are conducted randomly. Four were appraised in 1984; five are scheduled for 1985; and six for 1986. Internal audits are made as needed. For example, E&C is currently auditing its transmission line right-of-way clearing criteria and practices as a result of an increasing number of situations in which reclearing was required on newly constructed projects.

Scope of Field Appraisals

Field appraisals have been the most important component in the new Environmental Appraisal Program because they focus on the specific conditions at each facility in the BPA transmission system and recommend solutions for any problems, existing or potential.

BPA transfers power over a high-voltage transmission system (550-kV, 345-kV, 230-kV, 115-kV, 69-kV) that extends for more than 14 200 circuit miles and includes more than 400 substations. The system interconnects with 18 other public and private transmission systems at some 100 different points. BPA is continuing to add main grid, area service, customer service, maintenance, and support facilities to this system. The agency is also involved in the research and development of small hydro, wind, geothermal, biomass, conservation and other renewable energy demonstration projects. Environmental and regulatory compliance are an important aspect of these research and demonstration projects, as well as the construction and operation of facilities.

Field appraisals on newly constructed facilities have concentrated on recently constructed transmission lines and substations as well as one microwave radio station. The scope of each field appraisal is tailored to the specific project, but generally focuses on the environmental issues of most significance. These include: NEPA commitments; contractual environmental commitments; landowner agreements; and other legislative requirements.

Projects have been selected to give a representative look at: different environments encountered in the BPA Service Area; different types, scales, and complexity of project and construction practices; and effectiveness of mitigation at varying times up to three years after construction.

The field appraisal program for existing facilities has concentrated on large facilities located near environmentally sensitive areas. The program during 1984-85 has been directed at: hazardous and toxic waste management, noise, oil spill containment, and safe drinking water.

Many existing facilities were constructed before the emergence of most of the environmental laws and concerns that exist today. As a result, there is a substantive need to insure that existing facilities are evaluated and modernized. PCB disposal at existing facilities is of utility wide concern; for instance BPA has over 100 substations with PCB capacitors. There are over 140 000 high-voltage capacitors on the system which are insulated with PCB material. In addition, BPA has more than 32 sites where PCBs and other hazardous wastes are temporarily stored before disposal, and one long-term PCB and hazardous waste storage and handling facility where PCB contaminated equipment and oil are stored, tested, and processed for disposal. PCB disposal costs for 1986 will exceed $1.1 million.

Field Appraisal Process for Newly Constructed and Existing Facilities

The environmental appraisal process for newly constructed and existing projects is based on the self-audit concept using the original project design team or representatives from the involved line organizations as the basic review team. Figures 3 and 4 illustrate the basic processes being used. We have found that self-auditing brings the people most knowledgeable about a project together and makes them more aware of the environmental problems of a project.

Project managers for new facilities are responsible for seeing that: 1) the appraisals are done in a timely manner; 2) conflicts are resolved; 3) follow-up is taken on recommendations; 4) field appraisals are scheduled in a cost-effective manner; and 5) recommendations are presented to management. For field appraisals of existing facilities the environmental specialist from the Environmental Manager's office assumes these responsibilities.

For newly constructed projects, the assigned project environmental specialist from the Environmental Analysis Branch works with the appraisal team to develop an appraisal checklist. For existing facilities, this is a responsibility of the Environmental Manager's representative. He/she resolves questions on the scope of the appraisal with the project team, with the E&C Environmental Appraisal

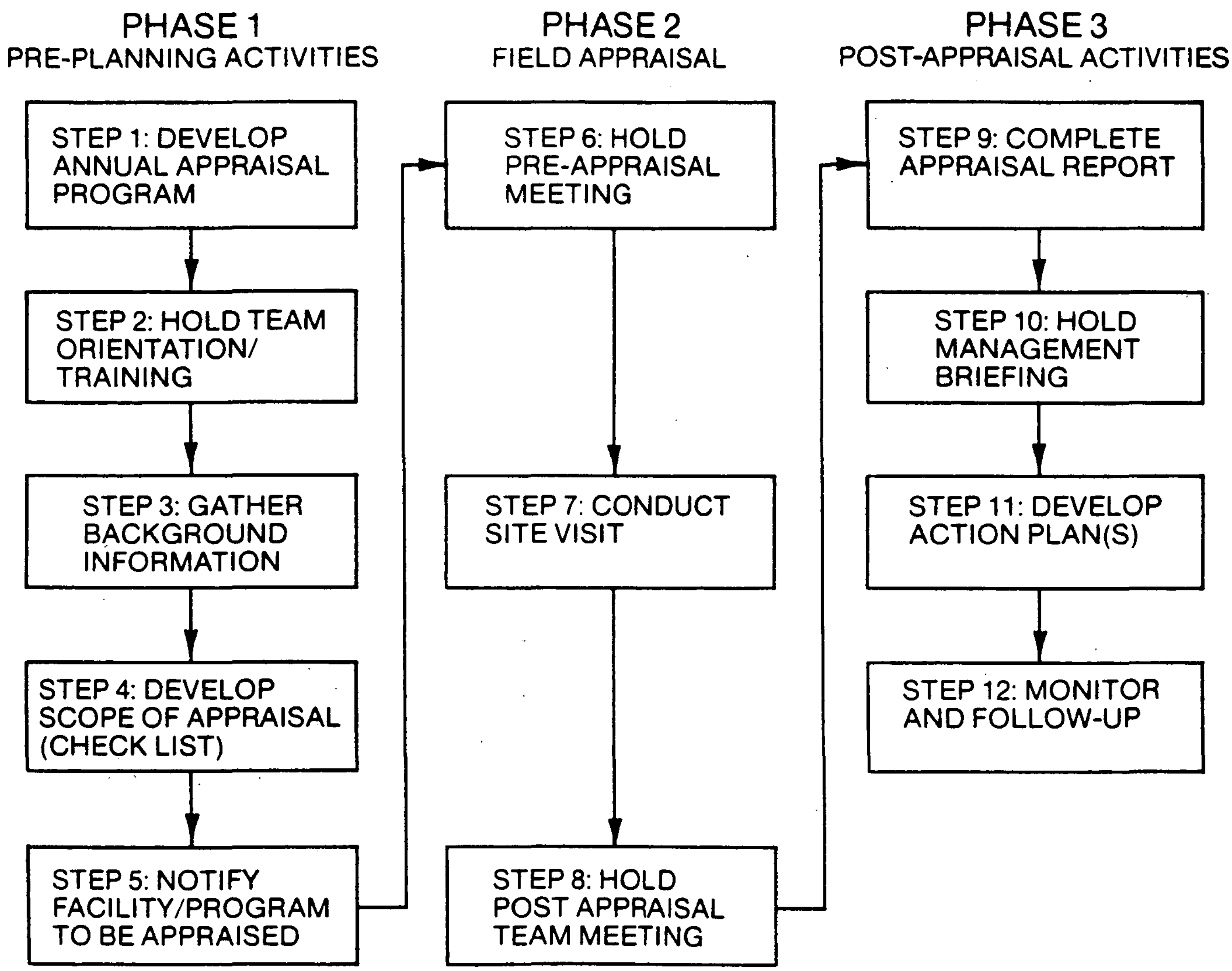


FIGURE 3 ENGINEER AND CONSTRUCTION APPRAISAL PROCESS
(Newly Constructed Facilities)

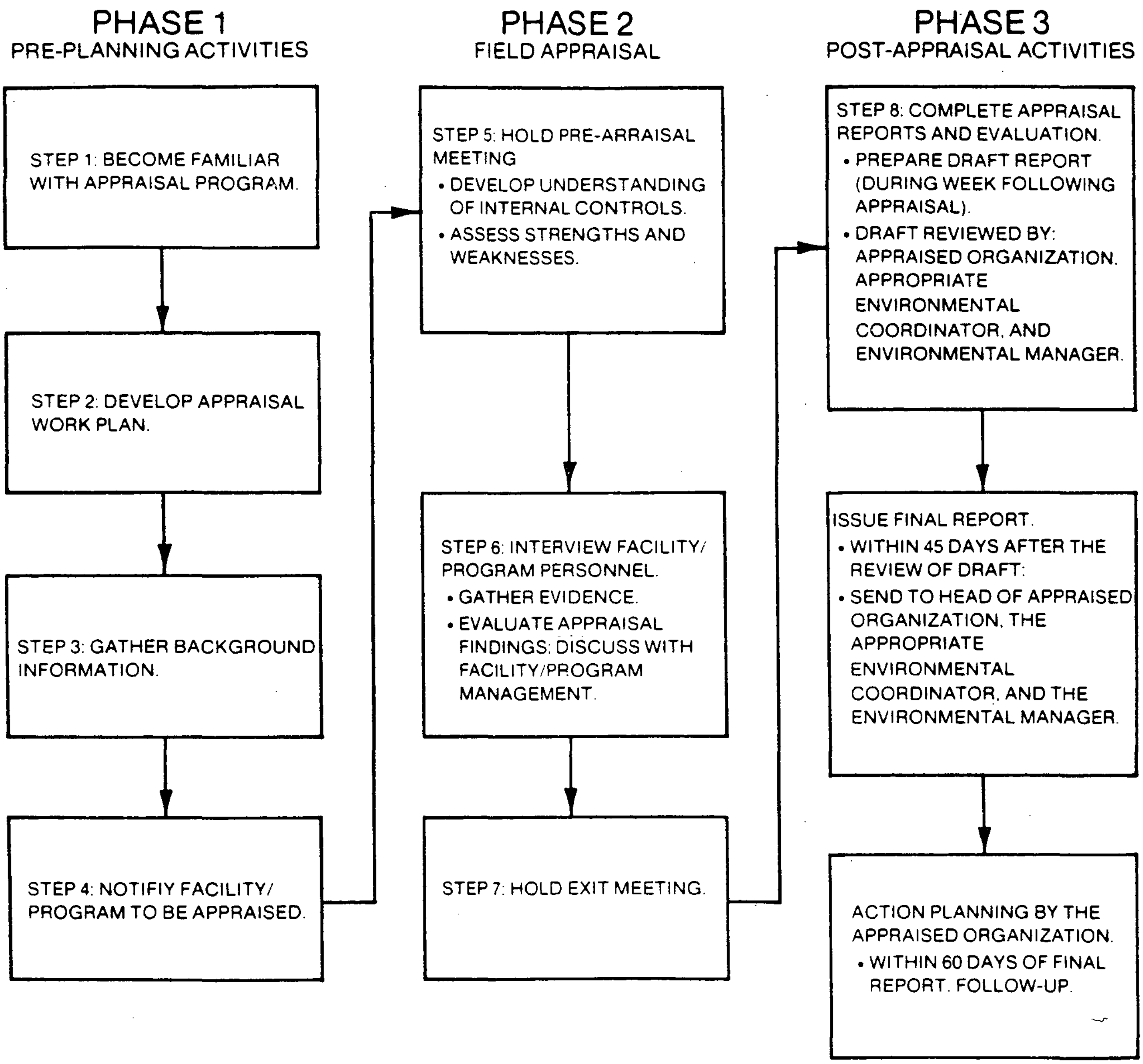


FIGURE 4 REGIONAL OPERATIONS
(Existing Facilities Appraisal Process)

Program Coordinator or RO Environmental Coordinator, and finally with the Environmental Manager. This process helps to insure the objectivity of the self-appraisal.

Team members are responsible for: 1) insuring that checklists adequately reflect their area of responsibility; 2) providing appraisal data from the organization they represent; 3) assisting in any investigations; 4) recommending any follow-up actions where deficiencies are noted; 5) insuring that follow-up actions which are the responsibility of their organization are carried out; and 6) participating in management briefings. The E&C Environmental Appraisal Program Coordinator, RO Environmental Coordinator, and the Environmental Manager's office are responsible for overseeing field appraisals.

Preplanning Activities - Phase I

The initial step of the preplanning phase is the development of the Annual Field Appraisal Program. For newly constructed projects the program identifies the projects, schedules, team members, and appraisal guidelines and serves as the primary guide for carrying out the program for that year. Once a team is approved, the E&C Environmental Appraisal Program Coordinator and the Environmental Manager's office hold a meeting to explain the program and appraisal process to the team members.

The Environmental Coordinator for RO develops the program for existing facilities, including the identification of projects and team members. The assigned appraisal team develops a work plan which defines the general approach to be used for the appraisal, the areas of concern to be investigated, and the specific information needed to complete the appraisal.

In the next major step, project team members gather background material and establish a project team file to be kept by the lead environmental specialist. For newly constructed facilities typical sources gathered include:

- Environmental impact statements
- Mitigation plans
- Construction specifications
- Landowner agreements
- Public meeting transcripts
- Decision documents
- Inspectors reports
- Design drawings
- Regulatory requirements
- Construction inspectors daily logs
- Other applicable data

These source documents provide a basis for the next step which involves identifying and prioritizing issues and developing the scope of the appraisal. This is normally done in the form of a checklist which is reviewed and approved by the appraisal team. Since the team members have different backgrounds and responsibilities, it is important that a consensus on the checklist be obtained before the actual field investigation is performed.

For existing facilities information to be gathered might include:

- Facility plans
- Material inventories
- Permits
- Test results
- Airphotos
- Organizational charts
- Policy manuals

The final step before the field appraisal is the notification of facility managers, any appropriate agencies, and involved utility customers. Meetings are scheduled as necessary.

Field Appraisal - Phase II

Once the checklist is established, facility managers notified, and meetings scheduled, the actual field appraisal or assessment and verification process begins. Field appraisals of power transmission facilities normally last two to four days, depending on the size of the facility and the number of priority issues identified.

Before touring the facility, the team meets with facility managers and with customer utility personnel (if appropriate) to explain the appraisal program and receive any information or concerns they may have. On new construction appraisals, meetings with government agency officials are normally combined with the field trip. These officials can accompany the appraisal team on the field appraisal if they so desire and their permission is required before evaluating projects on Federal or State lands.

The site visit is one of the most important steps of the appraisal process. Team members tour the facility, review and complete the checklist, quantifying findings where possible. Assessments are made using technical judgement where quantified data or standards are not available or where the scope or size of the project does not allow for detailed review. The final step of the site visit involves the holding of a post appraisal team meeting. At this time, the appraisal findings are evaluated by the team and a composite checklist is completed. Where findings indicate a problem, the team identifies items to be corrected. If corrections are of a minor nature and can be made by the field office, they are included on the checklist but not in the final report. For new construction, the post appraisal team meeting can be held in the field, if time allows, or in the central office. For existing facilities, an exit meeting is always held to debrief facility managers on the most significant results of the appraisal.

Post Appraisal Activities - Phase III

The third major phase of the Field Appraisal Program involves the following activities: 1) the completion of the draft Appraisal Report including findings and recommendations; 2) the presentation of the report to involved line managers and the Environmental Manager; 3) the identification or verification by management of issues requiring follow-up action; 4) the development of an action plan for resolving issues; and 5) the finalization of the Project Field Appraisal Report. Sixty days are allotted for the identification or completion of any follow-up actions required. The project environmental specialist and the E&C Environmental Appraisal Program Coordinator monitor the follow-up actions to make sure that they are carried out. Findings that are recurring or of a programmatic nature are flagged by management and included as part of the E&C Functional Appraisal. The Office of the E&C Environmental Coordinator keeps the official file for field appraisals of new facilities and the Environmental Manager keeps the file for existing projects.

Results of BPA Field Appraisals

Newly Constructed Facilities

The field appraisals have shown that, in most cases, BPA's environmental program for newly constructed facilities has been successful. The mitigation measures contained in the construction contracts were effective. If the measures had not achieved what was intended or unforeseen problems had arisen, corrective steps were usually under way. In other cases, the appraisal team provided the diversified expertise needed to find solutions.

Four newly constructed projects have been selected as case studies for projects audited during the first two years of the new Field Appraisal Program. The following is a summary of the findings.

Macks Inn-Madison

The Macks Inn-Madison project was audited in 1984. This 115-kV wood pole line, located near Yellowstone National Park, is a sensitive project. Major environmental concerns are the visual impacts of the line and it's effects on recreational activities (especially snowmobilers) and on wildlife habitat (grizzly bear and bald eagles). Many impacts were avoided during the planning stages of the project by locating the line in the least sensitive areas. However, some potential impacts remained and special measures were committed to by BPA. The appraisal followed up on these commitments.

To reduce visual impacts, the United States Forest Service (USFS) had required that structures in specified areas be painted a sage green color to blend with the background. The audit found that this color contrasted highly and the structures were in fact more visible than if they had been unpainted. In the future, BPA will examine such requirements using visual simulation techniques.

Because the right-of-way was used as a snowmobiler travel way, special guy wire marking had to be devised. Bright orange and yellow sleeves that fit over the guys were found to be very effective. They are recommended for use wherever guy wires present a similar hazard.

The Madison Substation was found to contain PCB-contaminated oil. This is being corrected. The operation of the oil containment system during periods of extended subzero weather is unknown. An action item was established to analyze this potential problem.

Libby

During 1985, a 230-kV double-circuit line between Sandpoint and Bonners Ferry in Northern Idaho was audited. This line crosses rural residential areas, farm and timber lands, and a State wildlife refuge. The project is unique in that three different structure types were used to mitigate impacts.

To mitigate visual impacts on the more populated areas, a new design concept was used. It consisted of three wood poles supporting a double-circuit line. The advantages were a lower profile that did not protrude above surrounding trees and dark color that blended with the background. A drawback brought up through the audit was that this design was unattractive and had a negative visual impact at close ranges. It was recommended that this design not be used where close viewing is likely to occur.

Lattice steel towers were used to cross farmland because they make longer spans possible. Two tubular steel poles were used at a critical lake crossing where a lattice structure, the only alternative, was visually unacceptable because of the sensitive location. The audit confirmed the appropriateness of these designs in areas where they were used.

One area of special concern, identified in the EIS, is prone to severe wind erosion because of the extremely sandy condition of the soil. The team viewed this area and found that extensive erosion was occurring at one of the tower sites. The maintenance representative on the team agreed to take preventive measures immediately.

Alderwood Area Service

The Alderwood Area Service project was audited in 1984. The project included a 115-kV transmission line and 115/12.5-kV, 25 MW substation located in an area of high public sensitivity, approximately 13 miles northwest of Eugene, Oregon. This project was unique because environmental issues associated with other utilities were evaluated. BPA shared structures with two other utilities. Particular emphasis was placed on right-of-way clearing, commitments made to landowners, and visual concerns.

The appraisal team found that the public was upset by the fact that clearing and construction occurred at different times. Each utility used a different criteria to determine clearing requirements. It was also found that insulator type and color were uncoordinated with unattractive results. The team recommended that BPA improve coordination with other utilities when designing clearing criteria and incorporate an insulator color policy into customer agreements on future projects of this type. Also, it was recommended that the substation be painted to blend with the dark colors of surrounding forests, when an outage of the facility could be scheduled.

The Alderwood Substation did not have an individualized on-site oil-spill control and countermeasures (SPCC) plan. Management recommendations included a SPCC plan to be kept at the substation site.

Devils Mountain Radio Station

The Devils Mountain Radio Station was audited in 1985. This communication site, about 6 miles southeast of Mount Vernon, Washington, was a former fire lookout, 1727 feet in elevation. Two other radio stations are located near BPA's facility.

The appraisal confirmed that the facility was built without significant environmental effects. It also found that no evaluation or consultation had been completed for special legislative requirements. It was recommended that future communication facility construction specifications contain a section dealing with environmental issues/mitigation.

It was also found that there was no documented policy or process which systematically addressed the mitigation of the visual impacts of communication facilities, even though they are among the most significant and mitigation is performed. A systematic process was recommended to deal positively with this issue on a resource responsive basis. It was recommended that the substation color policy be modified to include communication facilities, and that siting and design guidelines be developed to insure that visual impact mitigation is implemented at the most sensitive sites.

The major noise source at the radio station was from an emergency backup generator. The sound measurement of 94 (dBA) was recorded at the property line near the exhaust from the engine generator. Although this level is high, the generator is only used for emergency backup and is exempt from Washington's Administrative Code which states: "Sounds created by emergency equipment will be exempt from all provisions of the code". It was recommended, however, that noise should be considered in the siting and design of future radio sites even though exempt from code provisions. There were no noise sensitive properties near the Devils Mountain site.

Existing Facilities

Two existing facilities out of the 14 appraised were selected as case studies to illustrate the results of the completed audits. For the most part, the facilities met current standards, although they were designed for less stringent requirements. Some problems have, however, developed with deterioration of equipment or the absence of protective devices that would now be installed in any new facility. The following is a summary of the findings.

D.R. Keeler (500-kV) Substation and Maintenance Headquarters

The D.R. Keeler Substation and Maintenance Headquarters is a large complex located on the outskirts of Portland, Oregon. It is rapidly being surrounded by urban development. Large amounts of transformer oil are stored and used in transformers, breakers and other electrical equipment on the site. Vehicle fuel is stored in underground tanks and large capacitor banks have many old capacitors which contain PCB insulating material. In addition the site is used for hazardous waste storage and transfer. It was appraised in the summer of 1984.

Noise readings at substation property lines were well within Oregon noise standards. Noise attention barriers in response to complaints from nearby residents were found to be effective.

Capacitor banks with PCB's were found to be properly marked.

The appraisal recommended that a single securable, dedicated storage area for the collection of hazardous and/or PCB wastes be established. It was also recommended that as a standard practice sorbent material should be placed under equipment that had developed slow leaks and that the material should be changed periodically. A new form of containment was recommended for larger leaks. Maintenance to correct large leaks was to be scheduled as soon as possible.

Installation of a personnel gate in the yard fence was recommended to facilitate access to the existing grease trap (oil/water separator) and drainage outfall for maintenance and inspection.

The appraisal recommended that additional secondary containment be included in BPA's Oil Spill Prevention Program for the four oil storage tanks (10 000 gal/tanks).

Celilo HVDC Converter Station

The Celilo HVDC Converter Station, the terminal of the Pacific Northwest/Pacific Southwest DC Intertie, was appraised in May of 1985. It is a large facility with oil and hazardous waste storage and transfer requirements. Of particular note are the large amounts of mercury used in the valves for conversion of power from AC to DC.

The Celilo Substation was found to be in compliance with existing federal and state drinking water, hazardous and toxic waste and oil spill containment regulations with few exceptions.

The hazardous waste/PCB storage facility was currently under construction and near completion. It was recommended that a diagram of the floor plan, showing the location of contents, be placed on the outside of the structure.

It was recommended that a site-specific SPCC (Spill Prevention Control and Countermeasures) plan be developed and made available in a standardized location to all personnel. Since no contingency plan existed for addressing hazardous waste or PCBs in the event of fire, explosion or other accidents, it was also recommended that such a contingency plan should be developed and appended to the site-specific SPCC Plan.

All pertinent information related to the use and disposal of mercury was available in the Valve Foreman's office. It was recommended that it be incorporated into a standard operating procedure and posted in a readily available location.

The appraisal found that substation maintenance staff had discontinued laundering apparel worn inside valve tanks and had begun to use disposable clothing. Plans for an activated resin bed system to filter mercury contaminated wash water were being implemented.

Functional Appraisal

BPA prepared the first Functional Appraisal for the 1984 fiscal year. The scope of the appraisal included, among other program issues, an evaluation of the findings and recommendations made during the field appraisals and internal audits conducted that year. Issues of a programmatic or systemwide nature were addressed. Particular emphasis was placed on PCB and toxic wastes since they were of most concern to management. The following are a few examples of issues identified. Action on these issues was the responsibility of the involved office, such as Regional Operations or Engineering and Construction.

An Action Plan for the removal and replacement of leaking PCB Capacitors, a utility wide problem, was under development. It was recommended that BPA should implement the Action Plan based on the Environmental Protection Agency (EPA) regulations and develop an agencywide compliance strategy.

The BPA system includes oil/petroleum product storage or waste disposal in numerous above and below ground storage tanks and equipment. The field appraisals confirmed the need to complete individual site-specific SPCC plans for facilities containing or storing oil and contingency plans for hazards associated with spills, fires, or explosions, etc. BPA is currently in the process of developing SPCC plans for all facilities using or storing oil or petroleum products. Contingency plans for PCB's and/or hazardous wastes are also being developed for appropriate facilities.

It was found that no systematic testing of the integrity of underground tanks had been completed, although a program was being investigated. It was subsequently recommended that the integrity testing program and any retrofits should be established in coordination with the development of new EPA, state and local regulations and that monitoring be carried out on those sites located near to environmentally sensitive areas.

As a result of the management reviews completed on E&C field appraisals, an ad hoc committee was established to study the methods used in identifying and implementing environmentally related commitments made to the public and to land management agencies. The Committee has developed recommendations which include the use of a computerized Land Information System to record and retrieve, on a centralized basis, all commitments by land track. This will help ensure that commitments made during construction are recognized during the maintenance and operation of the facility years later.

Conclusions and Future Direction

The BPA Environmental Appraisal Program has been evolutionary with each appraisal improving upon the previous one. We have found that the program has served well as a vehicle to bridge organizational boundaries. The increased communication has helped to resolve misunderstandings and increase awareness. Project design, engineering and other technical personnel have had the opportunity to view the final product and have gained a much better understanding and appreciation of environmental regulations, policies and procedures. They have also been able to observe the final product (lines and substations) in operation. With limited time and personnel constraints, this had not always been possible. The field appraisal program also provided these same personnel the opportunity to inform their managers of what had happened in the field, along with ways to improve and report successes.

The involvement of other federal, state and local agencies in the field appraisals also helped to improve agency relations. Their involvement demonstrated BPA's serious commitment to environmental improvement. For instance, BPA received positive feedback from the U.S. Forest Service on the Buckly Summer-Lake and Macks Inn-Madison Field Appraisals. These comments came from managers who had originally had reservations about the projects. Finally, agencywide issues of significance have been identified as a result of the field appraisal and functional appraisal processes. These issues have been addressed and programs designed to resolve them.

The only major change envisioned for appraisals of existing facilities is the reduction in the number to be conducted each year. The 12 appraisals being completed in 1985 were found to be too many. A reduction in program size will allow more time for carrying out recommendations made in previous field appraisals and the annual functional appraisal. For new construction projects, the size of the program will remain about the same, but new areas, such as renewable energy resource demonstration projects, will also be covered.

Other changes in future appraisal programs are expected to be minor. The very important administrative procedures at BPA's central hazardous waste storage, process and transfer facilities and test laboratories will be appraised. Investigation of specific areas of concern, such as road location design or erosion control, may allow a more detailed assessment than can be undertaken when specific projects are evaluated. There is also a need to develop or improve upon the day-to-day auditing or monitoring processes used by field personnel on both new and existing projects. Improvement of these processes will help to eliminate future problems.

Finally, it is the intent of the future appraisal programs to systematically monitor progress in correcting and improving issues and actions identified in the appraisal process. Methods are being developed to systematically track this progress with the assistance of computer programs.

LA CLASSIFICATION TAXONOMIQUE DES STATIONS FORESTIÈRES: UN CADRE DE RÉFÉRENCE AU SUIVI ET À LA PRÉVISION DES EFFETS DE L'ACTION SYLVICOLE

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Résumé

Les impacts souvent négatifs associés à l'utilisation des territoires forestiers et une volonté politique d'optimiser la mise en valeur des ressources forestières nous obligent à développer notre capacité de prévoir les répercussions des actions envisagées. En partant du principe que "là où les conditions du milieu sont similaires, on aura une réaction similaire à une même intervention", une classification taxonomique des sites peut servir de cadre de référence efficace comme base du suivi des impacts et d'extrapolation, sur d'autres sites, des résultats de ce suivi. Plus qu'une simple classification cartographique, la classification taxonomique, à cause de son indépendance géographique, permet une extrapolation scientifique juste et facilement applicable. Une méthode de classification écologique adaptée au territoire forestier habité du Québec laisse entrevoir de grandes possibilités pour l'accumulation des connaissances nécessaires au contrôle, au suivi et aux prévisions dans une gestion améliorée de la ressource forestière.

Summary

The negative impacts associated with the use of forest lands in conjunction with the political will to optimize the management of Canada's forest resources, compels us to enhance our capability to predict adequately the repercussions of the different forest related activities. On the premise that "where similar ecological conditions are found we can expect similar ecological responses to the same intervention" a taxonomic classification of forest sites can serve as an effective framework for the monitoring of the environmental impacts of forest land uses and, subsequently, to the extrapolation of this knowledge to other equivalent sites. More so than a "mapping-only" classification which is place-dependant, a taxonomic

classification that is place-independant offers an operational and a scientific method for deducing valid principles. An ecological forest classification method, that has been adapted to Quebec's inhabited forest regions, shows interesting prospects for the accumulation of knowledge necessary for the improved management of these forest lands.

L'activité forestière constitue certainement l'une des activités perturbatrices des sites naturels les plus importantes au Québec et tout probablement au Canada, si ce n'est qu'en terme des superficies touchées annuellement. Au Québec seulement ce sont plus de 2000 km^2 qui sont exploitées à chaque année.

Si l'extraction des bois est la cause de changements dans l'écosystème, elle n'entraîne pas nécessairement des dommages du simple fait qu'il s'agit d'une perturbation du milieu (Weetman, 1983). La forêt a de tout temps subi des transformations qui sont dues à des perturbations d'origine naturelle ou anthropique. Dans une optique anthropocentrique, axée sur la société et ses besoins, ce sont les changements non-désirés qui constituent des incidences négatives à la qualité de vie. En effet, il y a impact négatif seulement si la modification de l'écosystème forestier:

- ne respecte pas les objectifs d'aménagement,
- diminue la capacité productive du milieu,
- nuit de façon évidente aux autres fonctions forestières.

Dans une utilisation harmonieuse du milieu forestier il est donc essentiel de pouvoir prévoir les effets de nos interventions et les changer, si nécessaire, pour minimiser ces incidences négatives. Une telle attitude, si elle a été souvent absente dans bon nombre d'interventions, doit maintenant devenir une préoccupation première dans la nouvelle phase forestière où s'embarque la province de Québec. En effet, d'une foresterie axée sur une récolte économique de la matière ligneuse dans des forêts primaires, on passe graduellement à une phase où l'on est confrontée au renouvellement de la ressource. Cette future foresterie axée sur la régénération et le développement de nouveaux peuplements a notamment comme outil privilégié la sylviculture. Dans la perspective de l'étude des incidences environnementales, la prescription sylvicole peut ainsi être considérée comme un acte de prévision des effets d'une future intervention.

Notre présentation a comme objet de proposer un moyen d'améliorer la qualité de la prescription sylvicole, l'outil de base de la sylviculture. C'est par la classification taxonomique des stations forestières, que nous croyons pouvoir améliorer notre capacité de prévoir les répercussions des actions sylvicoles envisagées et ainsi mieux contrôler les incidences environnementales des interventions forestières.

1. L'action sylvicole

Dans la mise en valeur des forêts, il y a divers degrés d'interventions qui va de la cueillette simple de la ressource jusqu'au scénario le plus sophistiquée de l'aménagement forestier intégré.

Tant et aussi longtemps que la forêt n'est pas source d'inquiétude dans sa capacité à répondre aux besoins de la société, on se limite à la récolte et peu d'efforts n'est mis dans sa connaissance et dans sa conservation. Il faut attendre que des signes évidents de dégradations se manifestent et que la satisfaction des besoins sont affectée pour émouvoir les agents de décision et les amener à faire des gestes concrets en faveur de la forêt.

L'histoire forestière mondiale renferme moultes cas qui confirment cet état de chose. Ceci répond bien à la loi de minimum d'effort à fournir pour satisfaire un besoin. Ce qui arrive aujourd'hui à la forêt québécoise, comme la dégradation des massifs, le défauts de régénération après coupe, le dépérissement des essences, les épidémies, les ruptures de stocks qui pointent à l'horizon, oblige les responsables à reconsidérer leurs attitudes et à proposer des politiques d'utilisation de la ressource basées sur la mise en valeur des forêts, bien plus que sur la récolte simple des bois. Le postulat selon lequel la nature sait régénérer de façon satisfaisante les sites soumis à l'exploitation est hasardeux sur trop de superficies. Il est impérieux de se tourner vers l'action sylvicole, lorsque l'on cherche à maximiser la production soutenue de biens et de services tout en minimisant les incidences négatives sur la capacité productive et les autres fonctions forestières.

L'action sylvicole a pour tâche de mettre à profit les processus écologiques qui se découlent dans l'écosystème forestier afin:

- de maximiser la production soutenue de biens et de services,
- tout en minimisant les incidences négatives sur la capacité productive du site ainsi que sur les autres fonctions forestières.

Par définition l'action sylvicole est donc une action de prévision qui ne peut se contenter du hasard de la coupe qui a laissé trop de forestiers perplexes par la passé.

Les besoins d'informations vont bien au-delà des quelques éléments sommaires de connaissance exigés par l'opération de récolte. L'action sylvicole, qui se situe dans le cadre de l'aménagement intégré des ressources forestières, est bien plus exigente. Depuis le diagnostic jusqu'au suivi en passant par la prescription et l'intervention, le sylviculteur éclairé et prévoyant ne peut être à l'aise s'il n'a pas à la portée de la main les moyens de prévoir les diverses incidences de son action (figure 1). Il doit pouvoir prévoir en particulier:

- les incidences tant qualitatives que quantitatives de l'action sylvicole sur la production ligneuse,
- les incidences de l'action sylvicole sur la capacité productive ligneuse, c'est-à-dire les impacts possibles sur le potential de production,
- et enfin les incidences de l'action sylvicole sur les autres fonctions forestières telles que la production faunique ou la fonction esthétique.

Les éléments prévisionnels utiles au sylviculteur peuvent être acquis de deux façons et même de trois si on fait un heureux mixage de l'une et de l'autre.

1. La première est la voie empirique qui est basée sur l'acquis d'une expérience au jour le jour. La source de connaissance est l'observation de réactions similaires du peuplement à une même action répétée plus ou moins au hasard. La sylviculture européenne doit beaucoup à cette voie qui lui a permis au cours du temps de développer une méthodologie d'intervention efficace malgré une faible connaissance des facteurs du milieu concerné par l'action sylvicole.
2. La seconde voie est une voie plus contrôlée basée sur une expérimentation systématique et sur une connaissance à priori de l'écologie du milieu et des essences forestières.

Les deux cheminements donnent des résultats adéquats. Cependant le premier exige beaucoup plus de temps que le second. La pratique sylvicole québécoise ayant peu de recul dans le temps, elle doit évidemment se tourner vers une systématisation de son expérience sylvicole si elle compte répondre dans les

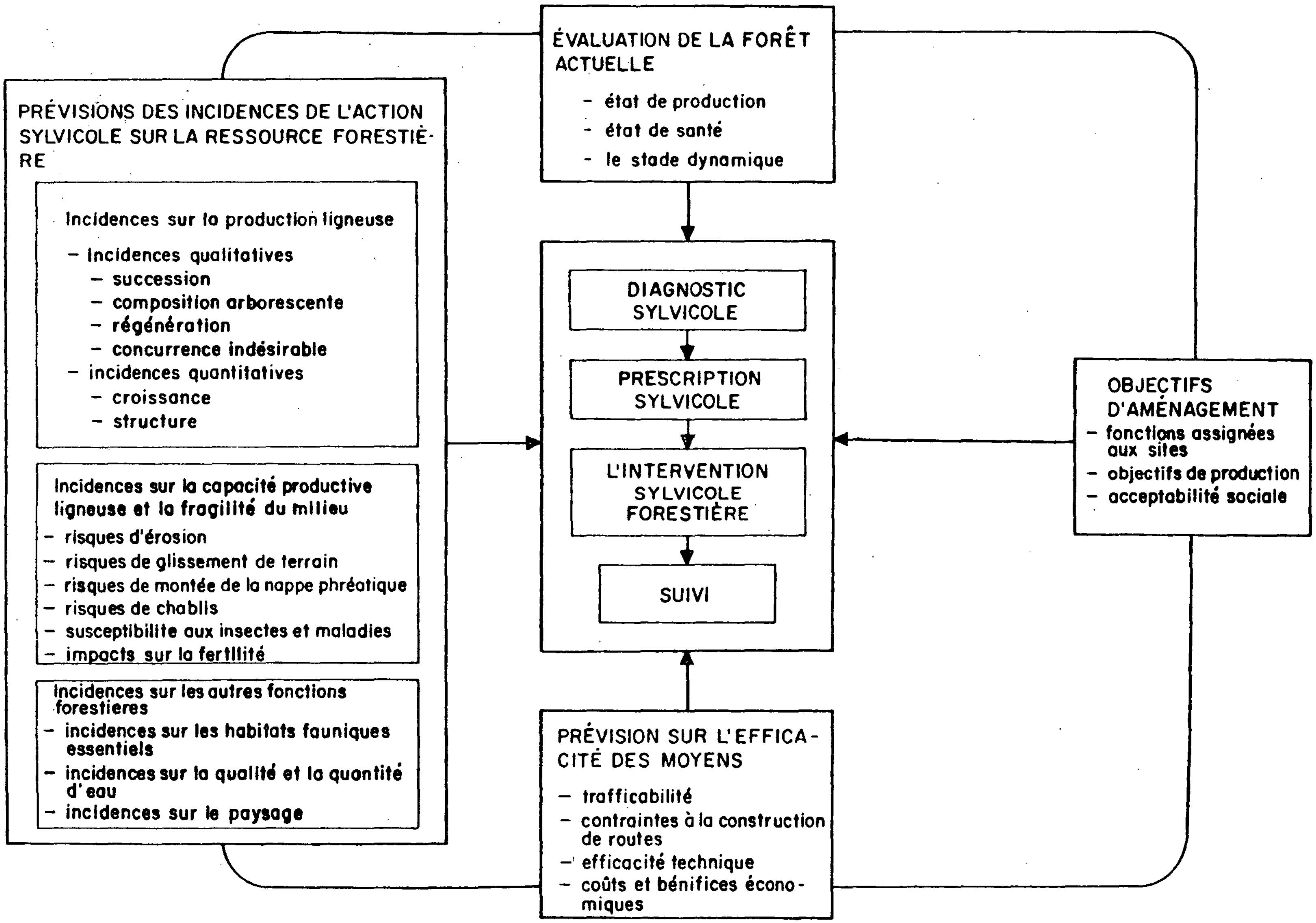

FIGURE 1 L'ACTION SYLVICOLE ET SES BESOINS D'INFORMATION

plus brefs délais aux besoins de prévisions exprimés. Tout en laissant de la place à l'empirisme elle devra pouvoir tirer le maximum de valeur prévisionnelle des quelques expériences sylvicoles qu'elle entreprendra au cours des prochaines années.

2. Un cadre de référence pour le suivi et la prévision: une classification taxonomique cartographiable

Pour améliorer nos capacités de prévisions nous proposons ainsi un outil qui permet de mieux intégrer nos expériences et surtout nous permet d'extrapoler avec confiance ces expériences à d'autres situations.

Cet outil de prévision se base sur un principe assez simple, soit que:

> là où les conditions du milieu sont similaires on peut s'attendre à une réaction similaire à une même intervention."

La démarche qui découle logiquement de ce principe est celle de la classification, plus particulièrement la classification taxonomique. Cette dernière constitue un processus par lequel on subdivise un ensemble complexe en une typologie de classes conceptuelles.

Le rôle d'une classification taxonomique est double (figure 2).

1. Elle fournit en premier lieu un cadre de référence efficace d'accumulation d'intégration et de conservation de la connaissance en produisant une typologie qui sert d'adresse pour stocker systématiquement de nouvelles expériences et pour en rappeler d'anciennes.
2. En second lieu, et c'est ce qui est vital, la classification taxonomique accroît notre capacité de prévision, en nous permettant d'extrapoler l'expérience acquise sur certains sites à d'autres sites qui se classent dans le même type.

La classification taxonomique doit être différenciée d'une classification uniquement cartographique (Bailey et al, 1978). Dans le premier cas on établit une typologie de classes conceptuelles fondées sur une généralisation des propriétés d'entités réelles échantillonnées. Le produit de cette classification taxonomique est une série de concepts qu'on dénomme types ou taxons. Comme ce sont des concepts ils n'ont aucune dépendance géographique. Dans le cas d'une classification cartographique on procède à une individualisation d'entités géographiques. Chaque unité ainsi produite représente une entité

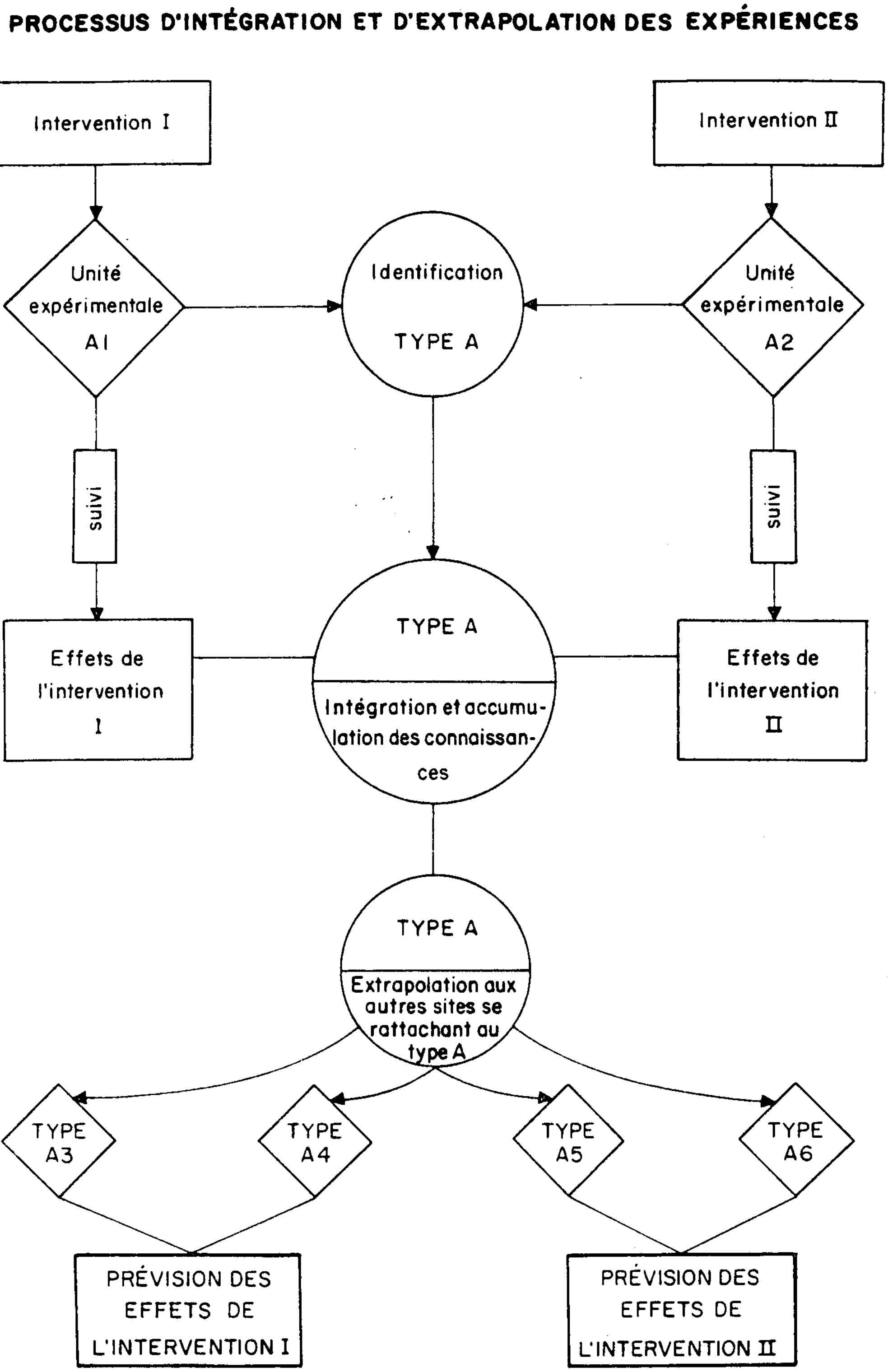

FIGURE 2 LE RÔLE D'UNE CLASSIFICATION TAXONOMIQUE DANS L'INTERVENTION

géographique, c'est-à-dire une portion de territoire réelle et unique. Ainsi donc, lors d'une classification taxonomique on réalise au départ un échantillonnage qui nous sert de base pour décrire des types après analyse de l'échantillon et de généralisation. On peut ensuite entreprendre une cartographie en associant les portions de territoires à l'un ou l'autre des types. Lors d'une classification cartographique on procède sans détour à l'individualisation de portions de territoires plus ou moins homogène en regard des critères pris en considération.

Or le grand désavantage d'une classification uniquement cartographique est qu'en principe chaque unité délimitée est unique et qu'en conséquence il est difficile d'extrapoler les expériences acquises d'une unité à l'autre. La classification taxonomique, au contraire, à cause justement de son indépendance géographique, nous permet une extrapolation scientifiquement juste et facilement applicable.

3. Le choix d'un concept typologique approprié en sylviculture

Pour élaborer une classification taxonomique valable, le choix d'un concept typologique qui réponde à nos attentes constitue la pierre angulaire du processus. En sylviculture, deux concepts typologiques sont plus couramment utilisés au Québec, soit le peuplement et la station forestière.

Le peuplement peut se définir comme une unité spécifiée par ses caractéristiques dendrométriques (composition et structure), dans laquelle on peut espérer le même produit à l'exploitation. Le peuplement est le concept le plus largement utilisé dans la pratique forestière au Québec. S'il en est ainsi, c'est principalement dû à la disponibilité pour le territoire québécois d'une typologie des peuplements et d'une cartographie issues du programme d'inventaire forestier du Ministère de l'Énergie et des Ressources.

Il faut retenir ici que la classification des peuplements élaborée par le M.E.R. n'a pas été développée pour satisfaire des objectifs sylvicoles mais bien dans un but de connaître les volumes de bois à récolter et à allouer au bénéficiaire d'un permis (MER, 1984).

En contrepartie, le concept de station forestière a nettement une connotation sylvicole (Decourt et al, 1981). La station forestière peut se définir comme une unité de terre spécifiée par ses caractéristiques écologiques et dendrométriques, dans laquelle on peut espérer les mêmes effets à l'action sylvicole.

Or présentement au Québec, une grande part des prescriptions sylvicoles se base sur la typologie des peuplements fournie par l'inventaire forestier et non sur une typologie des stations forestières. Pourtant l'utilisation du peuplement pour la prescription sylvicole présente des lacunes majeures. En fait dans de très nombreux cas il est impossible de faire une prévision sur les effets de l'intervention avec le moindrement d'assurance (Leak, 1980; Brown, 1983).

C'est le cas par exemple pour la prévision d'une strate de retour après coupe à blanc dans un peuplement identifié comme une sapinière à épinette dans la région bioclimatique de l'érablière à bouleau jaune. En effet si ce peuplement se trouve sur un dépôt sablonneux bien drainé on peut s'attendre à voir se développer une forêt mélangée soit une érablière rouge à sapin alors que si le même peuplement est sur affleurement rocheux on aura en toute probabilité une pessière rouge et sapin tandis que sur dépôt argileux mal drainé on peut prévoir un stade initial d'aulnaie à sapin (figure 3).

La cause principale des limites de la valeur prévisionnelle du peuplement est que ce concept n'envisage la forêt qu'en tant qu'ensemble d'arbres plutôt qu'en tant qu'écosystème. L'utilisation exclusive de la composition et de la structure du couvert arborescent comme base à la prescription sylvicole dénote une vision à court terme de la prescription ignorant les potentialités dynamiques et productives du milieu.

Le concept de station forestière, au contraire, est un concept écosystématique qui intègre cette vérité fondamentale que la forêt est foncièrement un écosystème composé d'un biosystème et d'un géosystème. La station forestière étant donc plus près de la réalité dynamique de la forêt, elle s'avère un concept typologique plus approprié pour entreprendre des prévisions en sylviculture.

L'outil ainsi proposé pour améliorer nos capacités de prévision lors de la prescription sylvicole, est une classification taxonomique des stations forestières qui puisse servir en premier lieu d'adresse pour stocker toute nouvelle connaissance et en second lieu de cadre de référence pour ensuite extrapoler avec un niveau minimum de confiance nos expériences sylvicoles. Il s'agit ainsi d'établir pour un territoire donné, un catalogue des types de stations forestières susceptibles d'être rencontrées, de présenter une description de chacune des stations et, enfin, de fournir des critères permettant leur identification et leur caratographie.

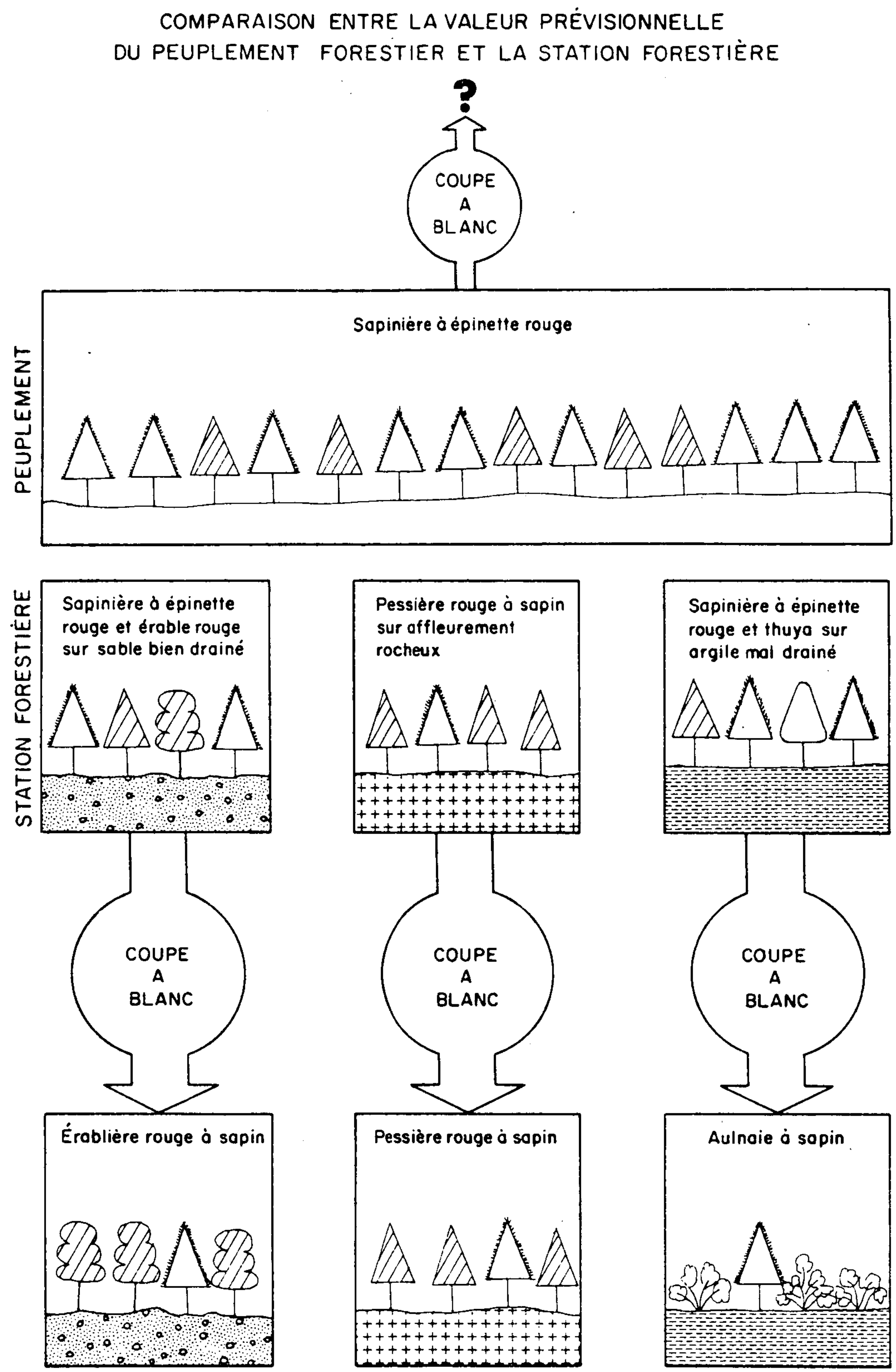

FIGURE 3 VALEURS PRÉVISIONNELLES DES CONCEPTS TYPOLOGIQUES DE PEUPLEMENT ET DE LA STATION FORESTIÈRE

4. La classification écologique du territoire: un cadre méthodologique pour entreprendre la classification des stations forestières.

Au Canada, un cadre méthodologique de nature écosystématique permettant de définir de manière efficace une typologie des stations forestières nous est fournie par un système d'inventaire écologique désigné par Environnement Canada (1981). Comme la classification écologique du territoire ou CET et connue plus spécifiquement au Québec comme l'inventaire écologique du Capital-Nature (Jurdant et al, 1977; Gérardin et Ducruc, 1979; Bélanger et al, 1983). La classification écologique du territoire représente l'une des méthodes écosystématique d'inventaire écologique les plus largement utilisées au Canada (CCCET, 1977; 1979). Elle est le résultat d'un programme national de recherche en inventaire écologique amorcé pour faire suite à l'Inventaire des Terres du Canada. Les premières lignes directives étaient établies il y a maintenant seize ans par le Comité national des terres forestières (Lacate, 1969).

La classification écologique du territoire consiste en une méthode intégrée et globaliste de levées du territoire par laquelle des zones territoriales sont classées en tant qu'écosystème selon leur homogénéité écologique. Le but est de classer et cartographier le territoire en limites identifiées, caractérisées et nommées par les composantes biophysiques les plus significatives et l'environnement qui reflètent le mieux les perspectives d'utilisation du milieu naturel. Basé sur le postulat que le territoire peut être décomposé en écosystèmes géographiques (land ecosystem) présentant des similarités dans leurs caractéristiques écologiques le système propose une intégration à priori des données climatiques, géologiques, géomorphologiques, topographiques, pédologiques, végétales et hydrographiques. Toutefois, les types géomorphologiques composent généralement le cadre dans lequel sont décrites et classifiées les autres variables biophysiques, le principe étant qu'elles affectent plus les autres facteurs écologiques qu'elles ne sont affectées par eux.

Même si on retrouve dans tous les inventaires écologiques se rapportant à cette méthodologie une communauté de pensée, il n'y a pas pour autant modèle unique (Rowe, 1979). En ce sens, la classification écologique du territoire constitue bien un cadre de référence méthodologique, cadre flexible permettant la mise au point de démarches spécifiques adaptées aux objectifs visés et aux particularités des zones étudiées. C'est ainsi que nous avons entrepris à adapter cette méthodologie au problème des territoires forestiers habités (Bélanger et al, 1983). Il faut noter que de l'approche originelle (Jurdant et al, 1975), deux grandes lignes de pensée quelque peu divergentes sont actuellement en développement. Du côté québécois, on reconnaît bien maintenant que l'inventaire écologique doit comprendre deux dimensions: une dimension taxonomique portant sur la typologie des unités et une dimension cartographique portant sur la délimitation spatiale des unités. Dans les dernières lignes directrices proposées par Environnement Canada (1981) on semble plutôt tendre à ne considérer que l'aspect cartographique. Alléguant que les définitions originales des unités écologiques avaient tendance à trop mettre d'emphase sur une composante particulière du milieu, on a cherché à les redéfinir dans une perspective plus holistique, en intégrant dans chacun des niveaux de perception toutes les composantes du milieu (Wiken et al, 1981; Environnement Canada, 1981). Toutefois, étant donné la valeur limitée d'une classification uniquement d'ordre cartographique comme cadre d'extrapolation, l'approche québécoise semble pour nous de loin plus avantageuse.

Dans l'approche québécoise, trois unités taxonomiques sont retenues pour circonscrire la station forestière: la région écologique qui nous fournit en premier lieu le cadre écoclimatique, le type écologique qui nous fournit en second lieu le cadre édaphique, géotechnique et phytodynamique et finalement la phase écologique qui nous fournit le cadre phytoécologique et dendrométrique soit l'unité qui nous donne une prescription stationnelle complète.

4.1 La région écologique

La première unité taxonomique, soit la région écologique, nous permet de circonscrire le cadre climatique fondamental à toute étude de la végétation et de sa dynamique (figure 4). La région écologique peut se définir comme une unité écoclimatique qui se caractérise par un climat régional distinctif tel qu'exprimé par la végétation soit dans sa physionomie, sa composition floristique ou sa dynamique. Dans une région écologique donnée on devrait notamment retrouver sur des conditions stationnelles équivalentes les mêmes chronoséquences végétales. La définition de ce cadre écoclimatique constitue un préalable essentiel à la définition des stations forestières. Ce n'est que

UNITÉS ÉCOCLIMATIQUES

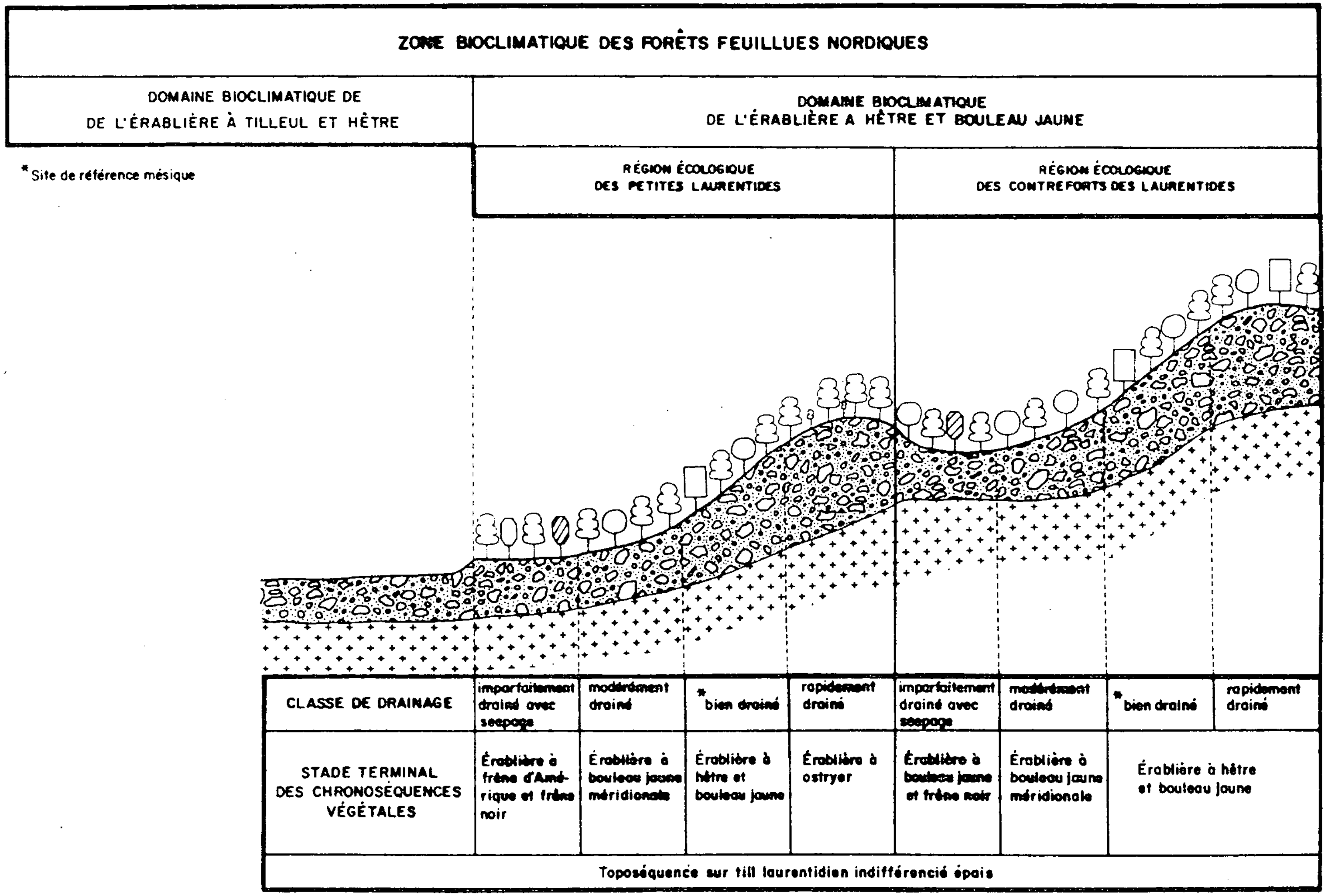

FIGURE 4 TROIS UNITÉS ÉCOCLIMATIQUES: LA ZONE BIOCLIMATIQUE, LE DOMAINE BIOCLIMATIQUE ET LA RÉGION BIOCLIMATIQUE. DANS UNE RÉGION ÉCOLOGIQUE DONNÉE, ON DEVRAIT RETROUVER SUR DES CONDITIONS STATIONNELLES ÉQUIVALENTES, LES MÊMES CHRONOSÉQUENCES VÉGÉTALES

lorsqu'on situe la prévision sylvicole dans une zone climatique homogène qu'on peut espérer atteindre un degré minimum de justesse.

4.2 Le type écologique

Le type écologique, quant à lui, se situe à ce niveau de perception écologique permettant de circonscrire les unités qui sont foncièrement homogènes dans leurs caractéristiques physiques et édaphiques stables qui induisent en particulier un dynamisme forestier particulier. Le type écologique représente une unité écologique permanente se distinguant en somme par un sol et une chronoséquence végétale donnée. Le type écologique, comme concept, peut être assimilé à celui du "site" ou "d'habitat" des anglosaxons c'est-à-dire un site où les facteurs écologiques affectant les conditions de croissance et la capacité productive sont uniformes (figure 5).

Le type écologique peut se définir comme une unité propre à une région écologique donnée caractérisée par un type géomorphologique et par une dynamique biologique propres qui induisent une prédisposition pour certains types d'utilisations. Le type géomorphologique, qui synthétise les caractéristiques du géosystème représente une unité physique homogène quant à la nature et l'origine du matériau meuble, les conditions de drainage et la pente. Quant à la facette dynamique du type écologique l'emphase est donnée habituellement aux chronoséquences végétales bien que critères de dynamiques fauniques et anthropiques puissent également être considérées.

4.3 La phase écologique

Le concept de phase écologique est le correspondant dans la classification écologique du territoire, du concept sylvicole de la station forestière. A l'homogénéité physique qui caractérise le type écologique, se rajoute dans la phase écologique, l'homogénéité de l'occupation actuelle du site, soit pour les milieux forestiers l'homogénéité du groupement forestier tant dans sa composition que dans sa structure. Alors que le type écologique est une unité écologique relativement permanente dans le temps, la phase écologique est une unité écologique transitoire. Elle peut être considérée comme une étape dans la chronoséquence végétale d'un type écologique donné. Dans un contexte forestier la phase écologique peut être définie comme une unité caractérisée par un type géomorphologique et un type de végétation donnés. Cette

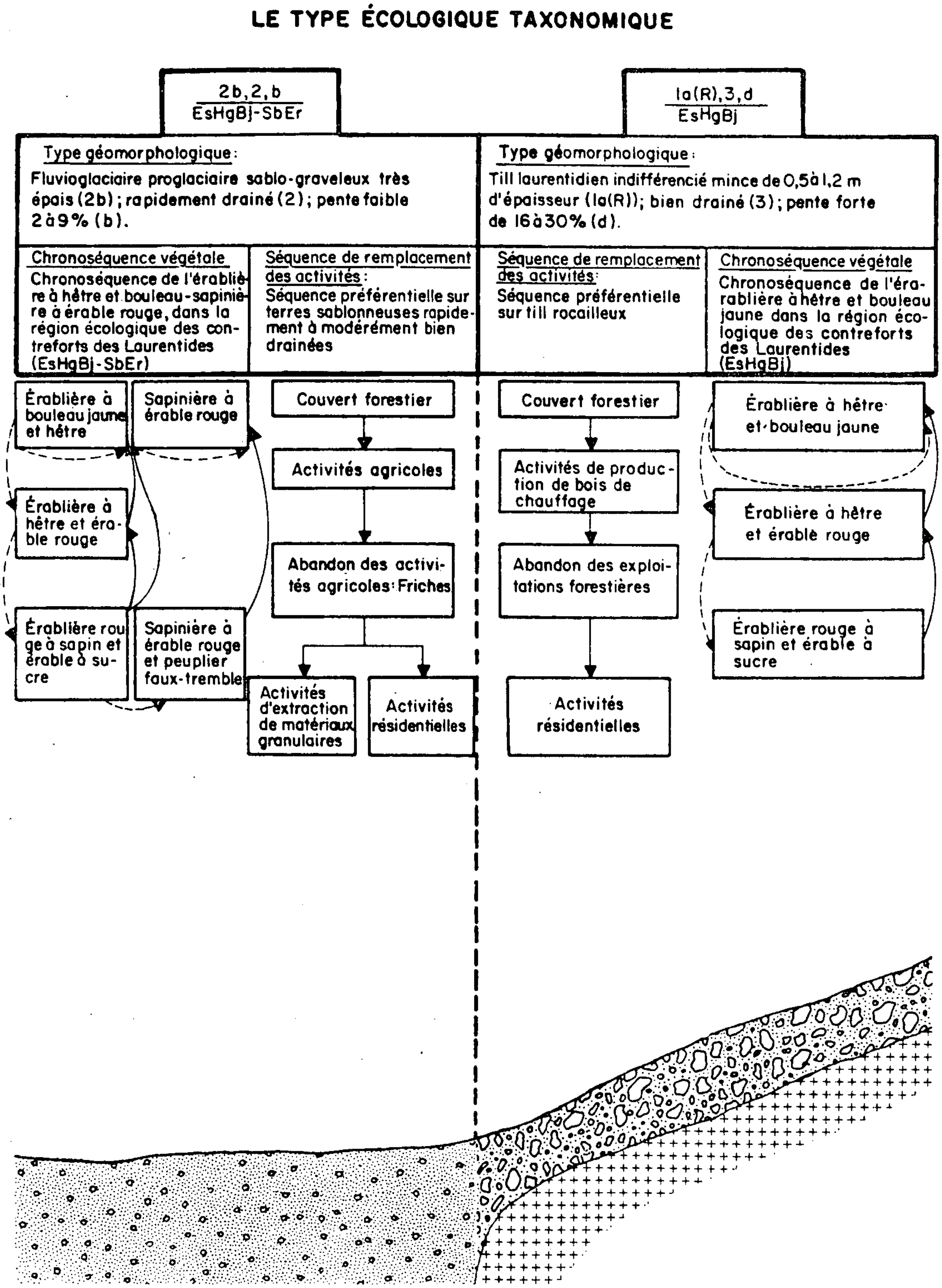

FIGURE 5 LE TYPE ÉCOLOGIQUE TAXONOMIQUE: UNITÉ CARACTÉRISÉE PAR UN TYPE GÉOMORPHOLOGIQUE DONNÉ ET PAR UNE DYNAMIQUE BIOLOGIQUE PROPRE QUI INDUISENT FRÉQUEMMENT UNE PRÉDISPOSITION À CERTAINES FORMES D'UTILISATIONS ET SÉQUENCES DE REMPLACEMENT D'ACTIVITÉS

définition doit par contre être élargie si l'on se situe en territoire habité. Il faut alors pouvoir classer également des sites occupés par des installations humaines telles que des habitations, des carrières ou des campings. La phase écologique peut alors se définir comme une unité caractérisée par un type géomorphologique et un type d'occupation (à dominance naturelle ou anthropique) uniformes (figure 6).

Conclusion

Au Québec l'utilisation de la méthodologie de l'inventaire du Capital-Nature pour effectuer la classification taxonomique des stations forestières devient graduellement plus généralisée tant au Ministère de l'Énergie et des Ressources (Gagnon et Marcotte, 1980; Thibault, 1985) qu'au Ministère de l'Environnement (Ducruc et Gérardin, 1985) qu'à la Faculté de Foresterie et de Géodésie de l'Université Laval (Bélanger et al, 1983; Bélanger, 1985).

L'amorce d'un réel programme de classification taxonomique des forêts sur la base du paradigme de la station forestière, constitue d'après nous, l'une des bases de connaissance fondamentale que doivent se donner les forestiers pour améliorer leurs capacités de prévision tant nécessaire pour entreprendre des actions sylvicoles qui miniminisent les impacts négatifs. Ce type de classification taxonomique standardisée est analogue à ce que ce sont donnés les agronomes avec la classification des sols.

Toutefois, l'élaboration d'une classification taxonomique des régions, des types écologiques et des phases écologiques n'est pas une fin en soi mais bien un moyen. C'est un moyen qui sert en premier lieu d'adresse pour stocker toute nouvelle expérience et, qui sert en second lieu, de cadre pour extrapoler l'expérience acquise à d'autres sites qui se classant dans le même type. La classification taxonomique ne constitue pas seule, une condition suffisante pour améliorer nos capacités de prévisions. Il faut donc que la base de données écologiques produite par la classification taxonomique devienne une réelle base d'informations sylvicoles. C'est dire qu'il faut pouvoir associer à chaque type de station forestière un ensemble de prévisions sous la forme d'aptitudes, de potentiels ou de risques. Ainsi sont livrées des informations plus immédiatement compréhensibles et utiles aux sylviculteurs.

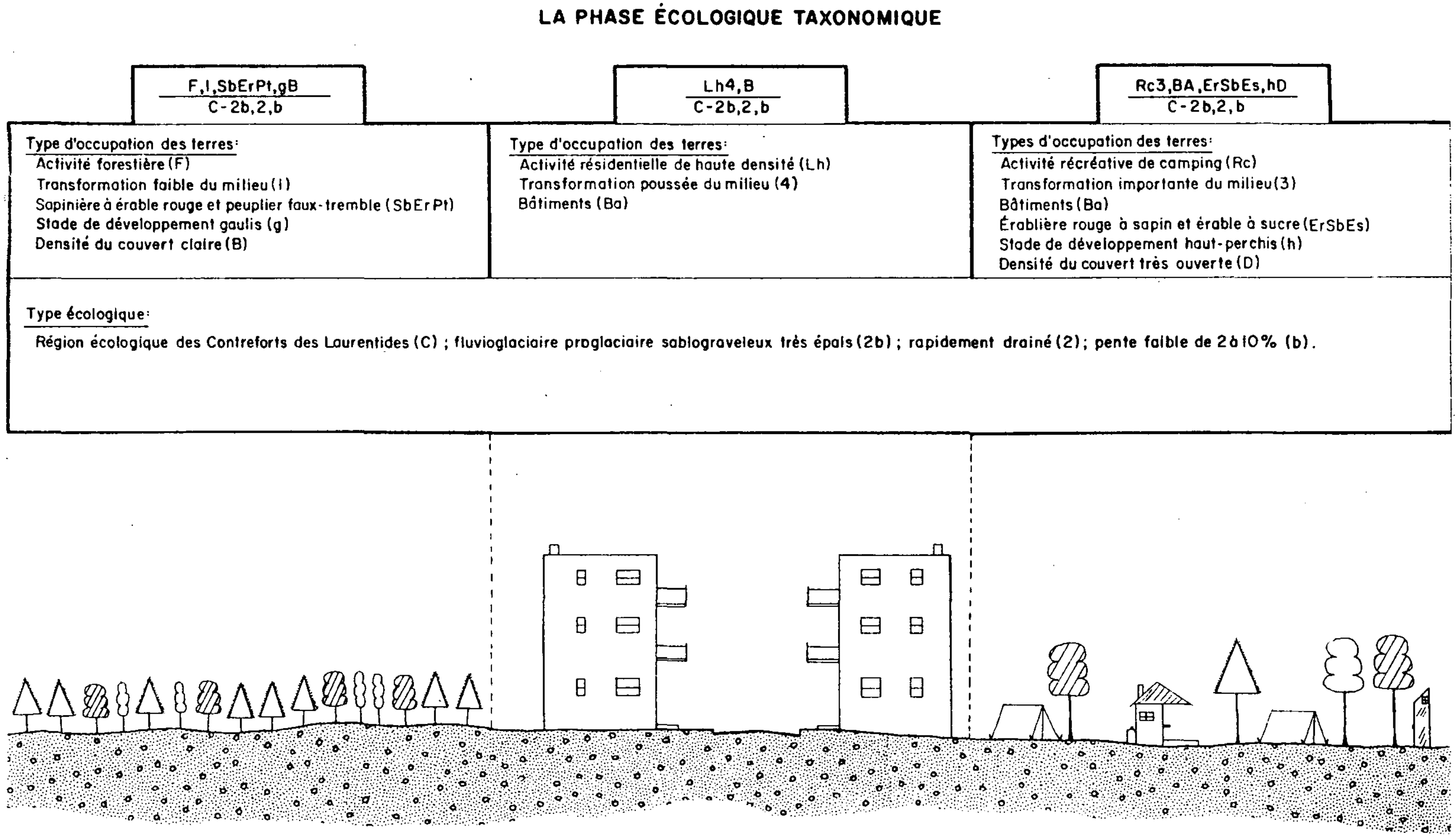

FIGURE 6 LA PHASE ÉCOLOGIQUE TAXONOMIQUE: UNITÉ CARACTÉRISÉE PAR UN TYPE GÉOMORPHOLOGIQUE ET UN TYPE D'OCCUPATION DES TERRES DONNÉS

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PART IV

ABSTRACTS

Papers presented at or accepted for the Conference,

but for which full text is not available

THE SHEBANDOWAN MINE: PREDICTED VS ACTUAL IMPACT A DECADE LATER

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Inco Ltd.

The Shebandowan Mine-Mill Complex, located in northwestern Ontario, was opened in 1972 after four years of environmental study and planning. It is one of the first Canadian examples of integrating an Environmental Impact Assessment process into the development of a base-metal mining operation.

It was important to incorporate environmental planning into the design of the Shebandowan Complex because of the sensitive location of the ore body. Nickel-copper ores were discovered beneath Shebandowan Lake, a popular wilderness vacationland. More than 750 cottages had been developed over the 34 km length of the lake. The EIA was carried out to ensure that the "wilderness" setting of the Shebandowan area would not be impaired.

Baseline monitoring programs were carried out at Shebandowan between 1969 and 1971. The environmental constraints identified, were used to guide the design of the mine-mill system to prevent environmental impairment. The main considerations which were dealt with, were the potential effects on the aesthetics and recreational use of the area, and downstream water quality.

Follow-up audits were carried out during the past thirteen years of operation at Shebandowan. Results of the audits show that the aesthetics and recreational use of the area were not impaired, and there were no measurable effects on the aquatic life in the receiving watercourse.

Many of the concepts and procedures used in modern-day Environmental Impact Assessments, were included in the development of the Shebandowan Complex, even though EIA Legislation in Canada was not enacted until 1974. Some of the procedures used in the Shebandowan EIA included scoping, baseline monitoring, public participation, the integration of environmental and design engineering, and follow-up audits. The EIA process at Shebandowan was simple, but effective. The administrative and procedural processes were streamlined, to allow efforts to focus on the major goal of the EIA, which was "the <u>prevention</u> of impairment to the environment".

The Shebandowan experience has shown that environmental considerations can be effectively incorporated into the design of a mining operation, with relatively minor additions to capital expenditures or operating costs.

Note:

Additional information, and other related publications concerning the Shebandowan project, can be obtained by contacting the authors.

THE ROLE OF MONITORING AS A TOOL IN DETERMINING ENVIRONMENTAL IMPACTS: A CASE STUDY OF MILITARY LOW LEVEL FLYING EXERCISES IN LABRADOR

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Labrador Inuit Association

In 1980 the Department of National Defence (DND) announced that the Luftwaffe would be coming to Labrador to do low level flying exercises, with a program to escalate these activities over the next few years. Pressure from public groups, particularly from the Labrador Inuit Association (LIA), resulted in the Department of National Defence completing an Initial Environmental Evaluation (IEE) of low level flying.

The main environmental concern for the Labrador Inuit is the potential disturbance to the caribou which are the cornerstone of their economy, their livelihood and their culture. Data on the effects of low level flying on caribou are extremely limited and the conclusions of DND in the IEE that the low level flying activities would have no negative impacts on caribou were based largely on generous extrapolation and were not considered by LIA to be a substantial conclusion.

Due to the lack of existing relevant data, the LIA took the position that a responsible and scientific monitoring program with LIA's involvement was the only way to get a more accurate understanding of possible impacts on caribou.

After five years of increased and systematic low level flying activity and increasing public opposition the federal government and the government of Newfoundland and Labrador have agreed to fund a monitoring program to determine the impacts on caribou to begin in the summer of 1985. The monitoring program will include the participation of the LIA in the design of the terms of reference through to the completion of the study.

This paper discusses how the monitoring study was designed and carried out, the role of LIA in monitoring and the degree to which the data from this program will be able to address the concerns of the Labrador Inuit about perceived threats to the caribou. The paper also considers the degree to which government's refusal to initiate a monitoring program back in 1980 has created an adversarial situation between the Labrador Inuit and the Department of National Defence over the past five years.

ENVIRONMENTAL IMPACT ASSESSMENT IN BRAZIL: PERSPECTIVES ON THE IMPLEMENTATION OF THE SYSTEM

Arnaldo Augusto Setti and Jose Euber Vascancelos Araujo
Government of Brazil

The Brazilian EIA system is still in its early stage of evolution. As such, most drawbacks of the current framework can be attributed to a lack of statutory provisions about the procedures of EIA. One of the most urgent and fundamental problems appears to be the absence of detailed specifications about the review of EIA documents. Currently, the law does not require coordination among concerned agencies and participation of the general public and is not specific about how external comments are summarized and utilized. These circumstances cause substantial role ambiguity among the agencies involved and reduce seriously the level of their accountability.

Implementation of EIA in Brazil is also hampered by the limited authority given to the special Environmental Agency (the Secretaria Especial de Meio Ambiente - SEMA), the central governmental instrument for the Brazilian EIA system. Statutory authorities allowed to SEMA include supervision of licensing processes and advising the National Environmental Council (Conseilo National de Meio Ambiente - CONAMA) about licensing rules. SEMA, however, is not yet formally empowered with the authority to review EIA documents. Its manpower is also too limited to supervise all state and local agencies' actions and state governments' licensing activities.

Between September 1981 and May 1983, a total of twenty EIA's were officially filed with the government. This represents an average of eleven EIA's per annum compared to eight for the Philippines and seven for Korea. The number seems very small in relative terms, considering the size of the Brazilian economy which is 5.4 times as large as the Philippine economy and 3.3 times the Korean one.

Despite the relatively small number of EIA's prepared, however, several projects, as a result of EIA, had to undertake changes in their plans. The effect of EIA implementation as a policy for environmental protection, according to SEMA's assessment, has been moderate.

The current institutional structure and implementation of the Brazilian EIA system suffers most from a lack of clearly established rules. The law is also evidently too lax about exemptions concerning petrochemical, chlorochemical, and nuclear power plants. Only a small number of projects which have potentially significant impacts on the environment seem to pursue the EIA obligation. SEMA officials concur that the Brazilian EIA is in its very beginning stage and point to the shortage of financial resources and technical manpower as additional problems for the implementation of EIA. On the whole, the impact of the EIA mandate on planning and decision-making processes thus far does not appear to have been highly significant. Nonetheless, the fact that some EIA's have led to changes in some projects suggests the EIA system is not serving a purely perfunctory role and indicates the possibility for institutional changes in the planning processes.

PREDICTION OF ENVIRONMENTAL IMPACTS AT A SILVER-GOLD MINE NEAR HOUSTON, BRITISH COLUMBIA

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B.C. Ministry of Environment

Equity Silver Mine, part of the Placer Development group, began operating a 6000 tonne/day silver and gold mine and concentrator in 1980 near Houston, B.C. The mineral deposit is complex, consisting of mostly pyrite, with pyrrhotite, chalcopyrite, tetrahedrite and numerous other minerals present. Environmental assessments were carried out by consulting firms and were subsequently evaluated by government agencies in the process of approving the mining proposal and issuing various permits for mining and discharging wastes. A single key feature was overlooked in this process which was the tendency for the waste rock produced by mining to generate sulphuric acid through oxidation of sulphates. The oxidation of sulphates occurred both chemically and biologically in the waste rock dump, and leached out with normal drainage.

By early 1981 it was apparent that creeks flowing off the property were receiving acid mine drainage which has a pH of about 2.5, was laden with dissolved heavy metals and was toxic to fish. A year or so later, seeps of acidified groundwater appeared some distance from the waste rock dump. Creeks from the mine site flow to streams used for domestic water supplies, and which form the headwaters of a major salmon and steelhead river. An expensive and only partially effective rearguard action has been mounted by the company to collect and treat the acid mine drainage. However, this has created a long-term water balance problem at the mine site. These problems persist to this date.

It is now clear that the baseline studies did not take the possibility of acid mine drainage into account. Currently, the company and regulatory agencies are attempting to evaluate the impacts of acid mine drainage on the receiving environment at the same time the impact is occurring. Baseline environmental conditions are not detailed enough to enable a before and after comparison. Managing the problem is proving to be expensive, which underscores the economics inherent in adequate project planning. The option of stopping mining is now unthinkable; not only is the community of Houston dependent on the mine for employment and taxes, but abandonment would leave the problem for public funds alone to solve.

This paper will analyze the baseline studies carried out in the planning stages, attempt to identify where the key decision points failed to anticipate this problem and explain how new monitoring programs are attempting to determine impacts on the receiving environment. Since the problem of acid mine drainage is of international interest, recommendations will be made to assist project planners to avoid this situation elsewhere.

ANALYSIS OF IMPACT MANAGEMENT PROGRAMS I. ENVIRONMENTAL SURVEILLANCE

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The Government of Newfoundland and Labrador instituted its environmental assessment process in 1975 and established the surveillance program in 1979. Surveillance is used here in the context of compliance, or regulatory, monitoring. An on-site officer is assigned to each major resource development to ensure that commitments made by the proponent in the EIS, terms and conditions of project approval and environmental protection legislation are carried out by the proponent and his work force. The officer reports to an Environmental Surveillance Committee composed of members of resource management departments. The Committee works towards resolving conflicts at the operational level and recommends changes in program implementation and policy to the Minister of Environment.

This post-assessment program has been applied at two hydro-electric and one forest access road developments over the past five years. Environmental surveillance has reduced the number of unplanned construction-related impacts and pollution incidents. However, lack of a legislative base has hampered the timely resolution of some incidents. Recommendations are suggested to improve program delivery, provide feedback to future project planners, engineers and regulators, and strengthen existing policy.

ENVIRONMENTAL ASSESSMENT AND SOCIOECONOMIC MONITORING: THE CASE OF HIGH-LEVEL NUCLEAR WASTE REPOSITORIES

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Social Impact Assessment Center

A generic problem of the environmental impact assessment (EIA) process as conducted under the National Environmental Policy Act of 1969 is the failure to provide for continuous monitoring throughout all phases of project development. Because of geotechnical and sociopolitical uncertainties, roughly proportional to project scale, development plans are subject to frequent and abrupt modification; EIA at one point in the approvals process does not accurately reflect actual and potential impacts arising from project-related activities. What you see once is distinctly not what you get later. A partial exception is found in the case of nuclear facilities, where radiological and other types of environmental monitoring are standard features. This does not extend to the monitoring of socioeconomic impacts, however, except for recent Tennessee Valley Authority (TVA) projects. In January 1985, the Office of Civilian Radioactive Waste Management, U.S. Department of Energy, released nine environmental assessments (EAs) for candidate sites under the National Waste Terminal Storage Program. NWTSP has been especially beset with uncertainties; "slippage" is a chronic tendency in its institutional history. The "issue tracking" feature of the EAs is mainly an indexing guide, not a monitoring of public concerns. In fact, public participation in issues identification and analysis has been minimal. That and the charged political climate surrounding repository development have produced a polarized, "zero-sum" situation which can be fairly characterized as a "worst case scenario" in its own right. The EAs do provide a basis for national site comparison at one point in time but, following the TVA model, the addition of socioeconomic monitoring and mitigation programs is required in order to recognize and regard alterations in the human environment as well as in the project itself. The State of Mississippi contracted in February 1985 with the Social Impact Assessment Center to perform a socioeconomic impact assessment of federal activities relating to candidate sites within its borders. This paper is based upon the experience of that baseline study.